Essays on macroeconomic policy

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Abstract

This thesis consists of four relatively independent essays in macroeconomics. Chapter 1 focuses on inflation targeting (IT) as a monetary framework. While the importance of achieving stable inflation is well established from a theoretical perspective, whether inflation targeting economies have achieved policy results which are significantly different from other regimes is still a subject of debate in the literature. This study contributes by addressing the endogeneity of IT adoption in a formal way and addresses Gertler's (2005) critique by contrasting the performance of IT against another clearly defined monetary framework. As results do not show much evidence in favour of IT in the long run, I explore other reasons for the success of IT. It turns out that apart from being a clearly defined policy framework, which puts pressure on a central bank to commit to policy targets and be transparent about its decisions, IT improves the dynamics of an economy's response to some of the common macro shocks.

In Chapter 2, I use Bayesian shrinkage methods to examine the determinants of the recovery after the recent financial crisis. Having examined a wide range of macroeconomic preconditions, I find that only the financial deepening and fiscal policy are the most important determinants of the recovery. Interestingly, even accounting for unconventional measures, the statistical significance of the monetary response is limited.

During the work on the Chapter 2, it became clear that measuring fiscal response is quite challenging and most of the statistical approaches are prone to serious issues. So, chapter 3 contributes by building an action-based dataset of fiscal decisions (2006 to 2015) on the basis of an examination of a range of policy documents. As a result I produce an index of a country's fiscal stance, which I subsequently use in my Chapter 2 to investigate the effect of fiscal policy on the recovery of output following the crisis.

Chapter 4 produces a regime-switching extension to a theoretical DSGE model of financial intermediation and unconventional monetary policy by Gertler and Karadi (2011), by allowing for switches in the capital quality process and an unconventional policy rule. Its important contribution is allowing for the possibility of switches to a zero-lower bound (ZLB) regime. It turns out that the agents may interpret a shock in various ways across the regimes, and that forms the dynamics of the system and results in certain welfare outcomes. For example, the possibility of a switch to ZLB massively influences the expectations of the agents and makes them behave very differently than they would in a model without a ZLB constraint. The results of Bayesian estimation fitted to quarterly US data show that even a simple New Keynesian model may be used as a tool to examine the economic history of the United States and explore the effects of unconventional monetary policy measures.

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Introduction to Thesis

This thesis explores several topics in macroeconomics. In my first essay, I explore inflation targeting as a monetary framework. Since 1989 when New Zealand pioneered the introduction of inflation targeting, many central banks have adopted IT as their formal monetary regime, while a number of others follow rules which are not very different from IT. In this thesis, I discover that this popularity of inflation targeting may not be explained merely by the improvement of long-run macroeconomic fundamentals, e.g. reduction of long-term average inflation, which for a long time was the consensus in the literature. Many countries adopted IT as a remedy against high inflation, among other reasons. This means that they are more likely to reduce their inflation levels once they have adopted IT. Additionally, as Gertler (2005) pointed out, the differences between the monetary paths of ITers and non-ITers may not be very clear-cut.

This study applies D-GMM and S-GMM to identify the impact of inflation targeting on the economic performance of the treatment group. The findings of this paper seem to be robust since the specifications control for common fixed and time effects, various regression to the mean effects and endogeneity of IT adoption. The findings are also robust to the variation in the sample. This addresses Gertler's (2005) critique since it allows us to contrast inflation targeting against other clearly defined monetary frameworks, e.g. exchange rate targeting.

Despite the absence of evidence on long-run macro improvement, estimation using a Bayesian panel-VAR shows that inflation targeting may still improve welfare by offering short-term stabilising properties. IT provides more stability when the economy is faced with asset price, economic growth and monetary policy shocks. Moreover, the positive effects of IT are even stronger as the public is confident in the ability of the central banks to adhere to their inflation targets, which seems to be the case in industrial countries. Inflation targeting can, therefore, remain an attractive framework since it offers high levels of transparency and flexibility in monetary policy, solves the time-inconsistency problem and helps to build the credibility of a central bank.

In my second chapter, I attempt to fill a gap in the literature by exploring the determinants of the recovery after the recent financial crisis by looking at a range of macro fundamentals and policy response variables.

Some of the existing studies have investigated the determinants of recovery from some past crises, for example, Hong and Tornell (2005); Aizenmann and Pasricha (2012); Jovanovic (2012). Most of those studies find a role for pre-crisis imbalances, macroprudential policy and some form of policy response. Other studies have looked into the determinants that may predict the exposure to financial crises. Another strand of literature examines the determinants of the exposure to the recent Great Recession. Among the most notable of those are Rose and Spiegel (2011); Olafsson and Petursson (2012); and Cecchetti et al., 2011. The results of this literature are more controversial, with some studies, e.g. Olafsson and Petursson (2012); Cecchetti et al. (2011), attributing better performance to better institutional quality and policy. Others find that predicting the exposure to recession is extremely difficult, arguing that good luck played a crucial role here, e.g. Rose and Spiegel (2011). The second chapter of this thesis connects those two strands of literature.

Employing Bayesian Model Averaging and other model shrinkage methods, I find out that the recent Great Recession has been even more challenging to predict than the preceding recessions. Among the preconditions, only financial deepening appeared as important. The countries where policy makers were more decisive and proactive in stimulating the economy in the traditional Keynesian sense have recovered faster after the Great Recession. During the recovery, the impact of fiscal policy seemed to have the most substantial effect. In line with Christiano, Eichenbaum and Rebelo (2011); Woodford (2011); and Swanson and Williams (2013) the size of the fiscal multiplier it is found to be larger than in the growth literature and this appears to be a consequence of the zero lower bound. This finding is also in sharp contrast with the expansionary fiscal contraction (EFC) hypothesis, which has become very influential following a range of studies by Alberto Alesina (e.g. Alesina and Perotti, 1995; Alesina and Ardagna, 2010).

We also find a conditionally negative sign of the change in the policy rate variable in almost every specification. As a response to the crisis, most of the countries in our sample drastically lowered their policy rates. Central banks faced with the effective lower bound for their nominal policy rates had to consider other options to bring the economies back to growth. Some central banks responded using so-called unconventional monetary measures. I make use of Krippner's shadow short rate database (https://www.rbnz.govt.nz/research-and-publications/research-programme/research-staff-profiles/leo-krippner) which maps the effect of unconventional measures on short rates. Then it takes adjusted short rates as a measure of policy rates in the US and UK.

However, even accounting for the unconventional measures the significance of the monetary response is weaker than that of the fiscal policy. This may support the findings by Goodhart and Ashworth (2012) and Martin and Milas (2012). Both studies indicate that QE might have been effective at initial stages of the recovery in preventing more substantial output contractions by reducing the borrowing cost. However, this does not necessarily imply that QE has a permanent effect on the improvement in credit and monetary growth.

One of the reasons why I identify the contractionary effect of fiscal austerity is that I am using a novel approach for fiscal response measurement. When estimating the impact of policy response on growth, it is important to isolate the cyclical component from the fiscal response. Unfortunately, the cyclically adjusted fiscal balances derived using Alesina's methods attribute an implausibly large proportion of the movement in structural balances to a deterministic component. As a result, cyclical adjustment does not abstract from all the cyclical influences and there still remains a clear common trend in the cross-country dataset. My third chapter focuses on constructing the factual database of fiscal policy decisions by looking into Budget Reports, Budget Speeches, Stability and Convergence Programmes submitted by the authorities to the European Commission, IMF Article IV consultation reports and OECD Economic Surveys. In some cases, I examine country-specific sources, such as the Congressional Budget Office (CBO) reports in the United States. As a result, I obtain a database which is based on governments' intentions at a particular point in time. This factual dataset presents a much more nuanced picture which is not as much distorted by the cycle. For example, in the United Kingdom, according to the IMF, the structural balance has always been in deficit in the aftermath of the financial crisis. In this dataset, however, we are able to capture the point that from 2011 the Coalition government opted for much larger-scale austerity measures than the

Labour government. I employ the database for the fiscal response measurement in my second chapter.

My fourth chapter examines the effects of monetary policy and financial intermediation on agent expectations by exploring the application of regime switching methods to Dynamic Stochastic General Equilibrium (DSGE) rational expectation models. I perform two calibrations of the Gertler and Karadi (2011) model allowing for the possibility of switches across the regimes with different capital quality and unconventional monetary policy rule parameters. In one of them, I allow for the possibility of a zero-lower-bound regime for the nominal policy rate. As a result, I find out that the mere possibility of the switch changes the dynamics of the economy even in non-binding ZLB regimes. One example is that in the presence of a ZLB in some regimes households may react to asset purchases as a sort of negative signal which suggests that the low interest rate and inflation steady state may prevail for longer, and households actually cut their consumption.

This signalling channel has already been analysed in the literature. In their seminal paper, Hayashi and Koeda (2014) analyzed the two-equation new Keynesian model of Eggertson and Woodford (2003) dealing with the severity of the zero lower bound and showed that with a positive monetary shock the economy is automatically sent to the liquidity trap, and when the monetary shock is set to zero a favourable equilibrium re-emerges. As a result, the model with zero-lower bound seems to be a much more relevant framework for the analysis of unconventional policy measures. It demonstrates that bringing about ‘helicopter money’ does not always work. In fact, in ‘crisis' and ‘recovery’ ZLB regimes, asset purchases not only cannot help economic growth but lead to welfare losses.

Next, I proceed to estimate the model by applying Bayesian methods. The model is fitted to quarterly US data. As an observable equivalent for the central bank portfolio, I use Lombardi and Zhu (2014)’s factor, which captures both US monetary aggregates and the Fed’s portfolio measures. The prior distributions are standard and are chosen in line with Smets and Wouters (2007). The results show that even a simple New Keynesian model may be used as a tool to examine the economic history of the United States and think about the effects of unconventional monetary policy measures. The economy shifted to ‘crisis’ and ‘recovery’ regimes quite often before 1983. During the Great Moderation, the stable regime prevailed, with switches to other regimes only at rather unstable times. Every NBER recession, including the recent financial crisis, has been characterised by shifts from the stable regime.

Interestingly, during the recent financial crisis, the economy has not experienced a switch to a binding ZLB regime. This is in line with Bullard (2010), who analysed the multiplicity of equilibria caused by Taylor rules. A key consideration here is whether the central bank persuades the agents that the asset purchases will continue until the policy outcomes are met. This is where ‘forward guidance’ may have been effective. On the other hand, it seems that the ‘lost decade’ in Japan prevailed for so long because policymakers were unable to engineer the exit from the liquidity trap.

CHAPTER 1: Assessing the effects of inflation targeting based on the international experience

1. Introduction

In December 1989, the Reserve Bank of New Zealand pioneered in the adoption of the inflation targeting (IT). Since then IT gained popularity and, according to Bank of England (2012), currently, 27 countries are using IT as a monetary strategy. Although initial inflation targeting was almost completely confined to industrial economies, the popularity of IT in emerging economies has been growing dramatically since the late 1990s. The fact that no central bank has abandoned IT (except for those which entered the Eurozone) is also quite striking and draws particular attention to this monetary regime.

Widespread adoption of IT poses lots of questions concerning the efficiency of inflation targeting. The two central questions addressed in this study are:

1. "Has inflation targeting been more efficient in improving macroeconomic fundamentals than alternative monetary regimes?"
2. "How do public and monetary policymakers react to macroeconomic shocks in inflation targeting countries?"

This study analyses the impact of IT on inflation, inflation volatility, output growth and output growth volatility for the sample of advanced and emerging countries.

In the existing literature, a consensus answer to the first question has not been reached. Early empirical studies by Bernanke et al. (1999); Corbo, Landerretche & Schmidt-Hebbel (2002); Hu (2003); Truman (2003) report evidence finding beneficial influence of IT on the subsequent macroeconomic performance; in particular they usually discover significant reduction in the inflation level and volatility and do not find any significant adverse impact on output growth behaviour. However, their results are derived without taking into account the prevailing trend to disinflate. Future inflation targeters usually start at a higher level of inflation and improve merely as a consequence of mean reversion. The first study that directly addresses this issue is Ball & Sheridan (2003) employing differences-in-differences OLS estimation controlling for the initial performance. This study does not find any conclusive evidence and produces a conclusion that IT does not make a difference in industrial countries. As discussed in further sections, their method does not allow exploiting all the available information, and, in some occasions, maybe not sharp enough to control for the endogeneity. Subsequent studies by Wu (2004); Mishkin and Schmidt-Hebbel (2007); Ball, 2010; Brito & Bystedt (2010); Vega and Winkelried (2005) and others also contributed to the analysis of IT performance.

Besides, there have been several attempts to answer the second questions, but usually considering individual inflation targeting economies and building the SVAR models maintaining a small open economy assumption. Mishkin & Schmidt-Hebbel (2007), in contrast, build a panel-VAR trying to look at the policy response in inflation targeting countries when faced with common shocks, most importantly oil price and exchange rate shocks.

This study analyses the effects of inflation targeting using the sample of advanced and emerging countries as classified by Laurens et al. (2006) during 1980-2014. It employs the dynamic panel data methodologies, e.g., D-GMM and S-GMM as well as Bayesian panel-VAR to check whether the conclusions reached are robust to variation in treatment and control groups.

One of the contributions of this study is that it directly addresses the critiques of Gertler (2005), who stated that for the analysis to be robust inflation targeting has to be compared with clearly defined alternative regimes. In one of the robustness checks, the control group is constructed from the exchange rate fixers. Exchange rate targeters are defined as countries fixing their exchange rate within 2% or less deviation from the defined target in the anchor currency.

This paper is structured in a way to meet the research objectives and answer the main research questions. Economic theory chapter explains theoretical framework and describes some potential advantages and disadvantages of IT. Literature review section covers the existing literature mainly for industrial and emerging countries and explains their contributions and problems of the research methodology. Data section introduces the sample, country classification and describes the nature of economic statistics. The methodology section discusses econometric issues of the specifications. Results and robustness check provide the interpretation of the regression results.

2. Economic theory

2.1 The motivation for inflation targeting

The choice of the monetary regime is an essential issue in economics. According to Fischer (1990), there exist two strands of literature that might justify intermediate targets in monetary policy: the rules against discretion debate which dates back to Simons (1936) and the targets and instruments literature initiated by Poole (1970).

Simons (1936) argued in favour of rules to prevent “discretionary actions” by monetary authorities, incentivized by political pressures. M. Friedman (1948, 1953) argued that lags in implementation make monetary policy such that it is actually destabilizing and proposed the use of money supply target. The development of the natural rate hypothesis by Friedman and Phelps (1967) had as an implication the absence of scope for monetary policy in the long-run, and the rational expectations hypothesis (Lucas, 1972) implied that there was no systematic scope for monetary policy even in the short-run.

All the ideas described were then developed into the concept of time-inconsistency by Kydland and Prescott (1977). According to this concept, both the authorities and the private sector would prefer to be at the natural rate of unemployment and with a lower level of inflation. However, it is not achievable since expectations of agents adjust. Kydland and Prescott show that the monetary authorities have to persuade the private sector that they are serious about inflation. If the monetary authorities announce a target, it raises the costs to themselves of reneging and markets are more likely to believe them. An alternative solution to the time-inconsistency problem is the delegation of monetary policy to an agent who has no incentive to pursue anything other than price stability, e.g., an independent central bank. Therefore, the rules versus

discretion debate produces a rationale for the adoption of intermediate targets in the form of the time-inconsistency argument.

Poole (1970) uses a static linear IS-LM model and contrasts two policies: "monetary," involving a monetary target and "Keynesian," involving an interest rate target. Which is preferable depends on the relative size of shocks, but in a situation when both types of shocks (IS and LM) are possible, the optimal monetary policy is a combination of both policies. B. Friedman (1975) argued that the monetary authorities do not control the money supply as such; they set interest rates and manipulate bank reserves to affect it. He showed that money supply should be used as an information variable about the size and nature of the shocks, and this information can be used in a way to help the monetary authorities attain the target level of income. Hence, the second strand of the literature concludes that the use of money supply as an intermediate target is not optimal.

Based both on theory and practice, Roger (2010) identifies the following guiding principles for a monetary policy framework:

1. Central banks are unable to pursue multiple goals with only one basic instrument – the policy interest rate.

2. The monetary authorities control nominal but not real rates in the long-run.

3. High inflation harms growth and the equitability of income distribution.

4. Considering expectations and maintaining credibility are essential for the effectiveness of monetary policy and the potential trade-offs between inflation and other macroeconomic objectives.

These principles pointed to a policy framework where monetary policy is conducted by an operationally independent central bank, ensuring a high level of transparency and accountability, and the monetary authorities are assigned a clear and credible objective of controlling the price level in the economy. Roger (2010) argues that inflation targeting central banks showed their ability to operate in this manner, while exchange rate and monetary targeting failed to yield acceptable results.

2.2 Inflation targeting as a targeting rule

As emphasised by Svensson (1999) inflation targeting can be considered as a targeting rule with an explicit loss function to be minimized. Most researchers have also agreed that this loss function should include concerns about the stability of the national economy, e,g. output volatility, which is consistent with the real-world general practice of central banks implementing "flexible" inflation targeting.

As shown by Woodford (2003) the objective of a central bank implementing inflation targeting can also be derived from a version of the New Keynesian model as a second-order Taylor approximation of the representative household utility function. This chapter presents only an abbreviated theoretical framework of the model and for a much more thorough treatment refer to Woodford (2003); Svensson (1999); and Svensson (2003).

In the general setup, the central bank is assumed to care only about two variables: inflation and the output gap:

$$\frac{1}{2}E_t \sum_{h=0}^{\infty} \beta^h((\pi_{t+h} - \pi^*)^2 + \lambda x_{t+h}^2) \quad (1)$$

Where β is the subjective discount factor, π_t the rate of inflation, π^* is the inflation target, x_t is the output gap and E_t is the expectation operator conditional on information set available at time t.

Monetary control is not perfect due to lags in the transmission mechanism, uncertainty about the transmission mechanism, the current state of the economy and future shocks to the economy, and the influence of factors other than monetary policy on inflation, in particular shocks that occur within the control lag (the h symbol identifies the shortest horizon at which monetary policy affects the economy). The approach discussed in this chapter is usually referred to as "forecast targeting."

The loss function is minimized subject to the structural model of the economy, which consists of a dynamic IS curve and a New Keynesian Phillips curve (Woodford 2003). Due to the time delay before the economy is affected by policy the dynamic IS curve is written as:

$$x_t = E_{t-h}x_{t+1} - \frac{1}{\sigma}(E_{t-h}i_t - E_{t-h}\pi_{t+1}) + E_{t-h}e_t \quad (2)$$

and the New Keynesian Phillips curve (or inflation-adjustment equation) as:

$$\pi_t = \beta E_{t-h}\pi_{t+1} + \alpha E_{t-h}x_t + E_{t-h}u_t) = 0 \quad (3)$$

However, it can be shown that the dynamic IS curve does not pose a binding constraint on the central bank, so the policy can be set up as if the central bank controls the output gap rather than the nominal interest rate.

In the case where the central bank places zero weight on the output gap, $\lambda = 0$, then the first-order condition takes the form:

$$E_{t-h}(\pi_{t+h} - \pi^*) = 0 \quad (4)$$

This is a strict inflation target. Intuitively, this target condition says that the central bank will adjust the policy to ensure that the inflation forecast does not deviate from target.

Since no central bank is committed to a strict target for inflation, flexible targets are considered to be a better characterization of central bank behaviour. This corresponds to the situation when $\lambda > 0$.

In this case, we obtain two first-order conditions with respect to inflation:

$$E_{t-h}(\pi_t - \pi^*) + \mu_t = 0 \quad (5)$$

$$E_{t-h}(\pi_{t+h} - \pi^*) + \mu_{t+h} - \mu_{t+h-1} = 0 \quad (6)$$

Where μ_t is the Lagrange multiplier from the optimization problem.

With respect to the output gap:

$$\lambda E_{t-h}x_{t+h} + \mu_{t+h} - \mu_{t+h-1} = 0 \quad (7)$$

The time-inconsistency of policy is clear and depending on how the central bank is assumed to optimize we obtain two different conditions. If the central bank pursues a discretionary monetary policy—that is, it re-optimizes policy in every period—then by combining (5) and (7), we obtain the following condition:

$$E_t(\pi_{t+h} + \emptyset x_{t+h} - \pi^*) = 0 \quad (8)$$

Condition (8) states that the central bank trades off inflation higher than target against output below capacity.

If the central bank optimizes from a timelessly optimal perspective (Woodford 2003), that is, ignoring (5) and taking into account only (6) and (7), its condition becomes:

$$E_t(\pi_{t+h} + \emptyset(x_{t+h} - x_{t+h-1}) - \pi^*) = 0 \quad (9)$$

The difference between the two conditions is the way the output gap enters into the condition.

With discretionary optimization, the central bank need not concern itself with the dynamic structure of the Phillips curve; it need only focus on the contemporaneous trade-off between the current output gap and inflation. Even in the case when the central bank is conservative in a sense that it has no incentive to maintain a positive output gap artificially, this policy may still suffer from the stabilization bias, which is essentially the welfare cost of being unable to influence inflation expectations.

Under commitment, the central bank needs to take into account the dynamic structure of the Phillips curve, in particular, the dependence of current inflation on future inflation. Hence the trade-off between inflation and output will have a dynamic structure, as in condition (9). Woodford (2003) shows that the solution to the timelessly optimal policy results in an inertial form of output gap-inflation process. This is because by conducting commitment policy the central bank can influence future inflation expectations, and this improves the trade-off between inflation and output variability and, hence, the welfare outcome. Therefore, as noted by Svensson (1999), inflation targeting being the strongest commitment ever practiced in history to a certain extent solves time-inconsistency issues by committing to a stable loss function.

The parameter $\emptyset$ captures the relative weight the output gap variable receives in the flexible inflation target. In this setup, $\emptyset$ is a function of the slope of the Phillips curve (α) and the weight on output in the central bank loss function (λ); specifically, $\emptyset = \lambda/\alpha$ (see Svensson 2003). The positive value for $\emptyset$ corresponds to the positive value for λ. Existing studies which empirically estimate λ, for example, Favero and Rovelli (2003) and Dennis (2004, 2006), find it to be very small or close to zero. Other studies, for example, Giannoni and Woodford (2005) and Otto and Voss (2014), estimate $\emptyset$ and find it of the order of 0.2-0.4.

As already mentioned, the loss function can be derived from the New Keynesian model, and therefore is fully microfounded. With nominal rigidities inflation results in relative price distortions between firms. Consumers change the demand for individual goods which leads to a dispersion of output across suppliers. From the consumer side, diminishing marginal utility implies that consuming more of the cheaper goods and less of the expensive goods results in the utility loss. Besides, due to diminishing marginal returns in production, the cost of producing more of the cheap goods is higher than the saved costs of producing less of the expensive goods. Therefore, the efficiency of the market pricing mechanism may be undermined. Fisher et

al. (1995) enumerate other reasons why inflation is detrimental to the economy. When unanticipated, inflation arbitrarily benefits debtors and hurts creditors, discourages saving and investment and distorts income distribution. It is costly even if anticipated since the absence of complete indexation (automatic adjustment for inflation) creates many technical difficulties. For example, through interaction with the tax system inflation raises tax burdens by artificially increasing profits. Therefore, even moderate inflation can be damaging since it produces serious distortions in labour contracts, accounting systems, and tax systems.

At the same time, Svensson (2003) argues that inflation targeting is a framework rather than an instrumental rule since IT also allows the use of judgmental adjustment and the incorporation of external information. It makes inflation targeting more robust and easier to verify and may bring the economy close to the socially optimal equilibrium. Bernanke, Laubach, Mishkin, and Posen (1999) also identify inflation targeting as a "look at everything" strategy with one focused goal. While the inflation target serves as a nominal anchor for the central bank, the central bank might have scope for "constrained discretion." Most crucially, announcing the target for inflation improves the communication between policy makers and public as well as provides accountability for policy making.

2.3 Main advantages and disadvantages in implementation.

Bernanke, Laubach, Mishkin, and Posen (1999) list several reasons that explain the increasing use of inflation targeting. First, policymakers were much more doubtful of their ability to effectively smooth short-run economic fluctuations, except perhaps those that are unusually severe or protracted. Further, macroeconomists had reached a consensus view that in the long run, the inflation rate is the only macroeconomic variable that monetary policy can affect. Second, macroeconomists agreed that even moderate rates of inflation are detrimental to economic efficiency and growth and that the maintenance of a low and stable inflation rate is essential for achieving other macroeconomic goals. Finally, the establishment of price stability as the primary long-run goal of monetary policy imposed discipline and accountability on the central bank.

As summarized by Batini & Laxton (BL, 2007) researchers identified the following advantages of inflation targeting:

1. Inflation targeting helps in building credibility and anchoring inflation expectations in a more fast and durable way. IT regime involves greater transparency and a more transparent nature of targets so that economic agents better understand the behaviour of the central bank.

2. IT offers greater flexibility. Since inflation targets are usually set for the medium term, short-term deviations from target are acceptable. Hence, IT involves greater flexibility, which reduces output variability.

3. IT involves a lower economic cost in the face of monetary policy failures. Failing to meet alternative targets, such as the exchange rate, involves massive losses of reserves, financial and banking crises, debt defaults. The cost of failing to meet an inflation target is limited to the inflation increase and the slowdown in economic growth due to the need to raise interest rates.

BL (2007) also outline main disadvantages of IT:

1. Inflation targeting involves too little discretion and unnecessarily harms growth.

In order to convince economic agents that they are serious about attaining the target, the monetary authorities have to react aggressively to inflation volatility. Thus, IT is too confining regarding the ex-ante commitment, which is likely to hinder growth.

2. IT cannot anchor expectations, because it offers too much discretion. In contrast to those who argue that IT is too restraining, some argue that IT cannot help build credibility since it offers too much discretion over how the inflation should be brought back to target.

3. IT implies high exchange rate variability since policymakers concentrate only on price stability.

4. IT cannot work in countries not meeting a stringent set of preconditions, making it unsuitable for most emerging economies. Preconditions include the technical capacity to implement IT, the absence of fiscal dominance, developed financial markets, the central bank independence and others.

Besides, Cobham (2002) argues that the IT regime involves some short-run stabilization weaknesses when compared to alternative monetary regimes, such as monetary, nominal

income or exchange rate targeting. The inflation targeting regime performs quite well in times of shocks due to domestic expenditure, money demand, foreign expenditure, foreign asset prices and foreign exchange risk premium. At the same time, there are some theoretical pitfalls of IT. First, it destabilizes the economy in times of supply shocks. Second, inflation is not susceptible to precise or immediate control by the monetary authorities, with lags in implementation being among the longest when compared to alternative regimes (estimated to be around 18-24 months). Besides that, it is acknowledged that inflation out of the purely domestic targets is the most difficult to control.

Empirically, many studies have confirmed the theoretical assumptions, and favour IT. However, there has been substantial debate over the robustness of these findings. This brings us to the literature review section.

3. Literature review

As discussed in the previous chapter, theoretically, inflation targeting possesses some appealing features compared to other monetary regimes. This assumption was tested quite often in empirical studies, but the consensus has not been reached. In this section, I review existing studies on the performance of IT and provide some critical comments on the methodology of their research.

If we examine inflation-targeting alone, we notice that their fundamentals improve after the regime adoption. For example, first two moments of inflation fell, output growth stabilized. However, non-ITers also experienced such improvements. So the natural question to ask in this context is: are the improvements in performance observed in countries that have adopted inflation the direct result of regime choice? This is the key question addressed in the literature, the answer to which remains ambiguous.

Since most studies have been conducted for the industrial countries, I first summarize the evidence for industrial countries, paying particular attention to the methodology of their research. Then, I provide an overview of existing literature on the effects of IT in emerging economies.

3.1 Difference-in-Differences

In their seminal work Ball & Sheridan (BS, 2003) analysed a sample of twenty advanced economies considering samples starting from 1960 and 1985 and splitting the sample of ITers into constant and non-constant (converging to long-run inflation targeting goal). The main contribution of the paper was that the authors emphasized the endogeneity of inflation-targeting regime choice and suggested interesting methodology of research.

At first sight standard "difference-in-differences" regression can be considered:

$$Xpost - Xpre = a_0 + a_1 D + e_i \quad (10)$$

Where Xpost is a country's mean value of X (measure of economic performance) in the post-targeting period, Xpre is the mean value in the pre-targeting period, and D is a dummy variable equal to 1 if the country is a targeter. The coefficient a_1 is meant to measure the effect of targeting on the variable X. For non-IT countries pre and post IT periods are defined as average of the date when all IT countries adopted IT:

However, running this regression would yield a biased estimate of a_1. First, historically, those countries with worse initial performance are more likely to adopt IT, as a strategy to improve. Second, the countries with worse initial performance will perform better during the treatment period just as a consequence of so-called "mean-regression". A researcher who does not pay attention to this issue is likely find a_1 biased upwards, or in other words, overestimate the impact of inflation-targeting adoption on the subsequent improvement of economic performance. Mathematically, endogeneity of D is a result of the fact that high level of $Xpre$ and $Xpost - Xpre$ are negatively related. It reflects the regression to mean: high level of $Xpre$ would imply the decrease during the transitory period and this effect exists regardless of whether country adopts IT. Hence, D is correlated with error term.

Ball & Sheridan (2003) suggested modifying the regression equation in the following way:

$$Xpost - Xpre = a_0 + a_1 \mathrm{D} + a_2 Xpre + e_i \quad (11)$$

According to their argument, e_i reflects the change in X_i that is not explained by either D or $Xpre$. So, variation in $Xpre$ does not affect error term, the problem of endogeneity does not arise and significant estimate of a_1 would provide evidence on IT performance.

As a result of the estimation of the equation (11) BS find that if mean inflation, X_i, is taken as a measure of economic performance then a_1 is not significant, the result which stays in contrast to the estimation of the equation (10). They also find that volatility of interest rates does not depend on IT adoption. Besides, they find no conclusive evidence about the effect of IT adoption on the inflation persistence and variability. The estimates regarding the behavior of output growth are very imprecise due to great variability of cross-country growth rates and data availability in 2005.

The results of BS were then confirmed by Ball (2010), who rigorously proved why estimation of the equation (11) eliminates the bias in a_1. Ball (2010) uses the same sample of countries, but argues that since many European countries (including Spain and Finland which previously practiced IT) adopted euro, giving up national monetary policy, so it should be taken into account. He modifies the equation (11) as follows:

$$X_{it} - X_{it-1} = aD_t^2 + bD_t^3 + cI_{it} + dE_{it} + eX_{it-1} * D_t^2 + fX_{it-1} * D_t^3 + e_{it}; t = 1,2,3 \quad (12)$$

In this regression, the variables of interest are I_{it} and E_{it}. D_t^2 and D_t^3 are dummy variables for periods 2 and 3, they are added to allow a constant to differ across time periods. Interactions are included to allow for regression to mean effects.

I_{it} = 1 if country i switched from traditional policy in period t-1 to IT in period t; =0 otherwise

E_{it} =1 if country i switched from traditional or IT in t-1 to the euro in period t; =0 otherwise

In period 1, all countries have traditional monetary policy. In period 2, which starts in the early 1990s, some switch to IT. In period 3, starting in the late 1990s, additional countries adopt IT and some countries switch from their period 2 regime to euro. Note that, if a country changes traditional monetary policy to euro in period t, then $I_{it} = 1$ E_{it} =1 (so the impact is c+d).

Ball (2010) finds few results robust. The only beneficial effect for IT is that it reduces mean inflation by 0.65 percentage point (hereinafter pp), which is not negligible, but not a huge improvement as well. At the same time, he finds some weak evidence that IT raises the mean and standard deviation of long-term nominal interest rates. Then robustness checks were applied (e.g all countries which have been members of European Monetary System excluded from sample or allowing for both short-run and long-run effects of IT adoption) and those finding become even weaker and sometimes effect of IT on average inflation becomes insignificant. Overall, Ball reports results similar to BS with no strong evidence either for or against inflation targeting.

Works by BS and Ball were criticized for employing cross-sectional specification, which largely ignores time dimension. As pointed out by Mishkin & Schmidt-Hebbel (2007) exploiting panel data is more likely to yield precise estimates. Bertrand et al. (2004) proves that ignoring time series information can only work well if "pre" and "post" time windows are identical across observations. Since in BS and Ball`s works they are not coincident and non-IT windows are defined arbitrarily via averaging procedure, their cross-sectional approach loses statistical power. Moreover, controlling for initial performance does not entirely eliminate endogeneity of IT adoption due to existence of other factors influencing macroeconomic performance, such as sociopolitical instability or level of corruption in economy.

Wu (2004a) studies the effect of IT adoption in 22 OECD industrial countries (quarterly data from 1985-2002), by estimating difference-in-difference equation in panel data setting. First, finds that reduction in inflation rates in IT countries cannot be explained by mean reversion, which is in contrast with BS. Then Wu checks whether the relatively better performance of inflation targeters is due to more aggressive monetary policy. He considers the following equations:

$$r_{it} = a + bIT_{it} + c\delta_t + d\lambda_i \quad (13)$$

$$\pi_{it} = a + bIT_{it} + c\pi_{it-1} + dr_{it-2} + e\delta_t + f\lambda_i \quad (14)$$

The equation (14) can be regarded as a reduced form solution of substitution an IS curve (13) into a Phillips Curve. r_{it-2} is lagged two periods backwards, since it is argued that it takes at least 1 quarter for real interest rate to affect output gap (through the IS curve), and another quarter to affect inflation.

After performing the estimation of the equation (14) Wu finds that b is negative and significant after allowing for the impact of real interest rate. It means that inflation targeting reduces inflation even after controlling for the impact of real interest rate.

Although including time and country fixed effects helps to deal with reverse causality between IT_{it} and π_{it} , it is still may be not completely resolved. Besides in papers by BS, Ball and Wu omitted variable bias still remains unresolved. Therefore, instrumental variables can be helpful.

3.2 Instrumental variables and GMM

Mishkin and Schmidt-Hebbel (MS, 2007) focus on a large panel sample of quarterly data for thirty-four countries (industrial and emerging) over 1989-2004.

They specify inflation as weighted average:

$$\pi_{it} = \lambda\pi_{it}^{*} + (1-\lambda)\pi_{it-1} + e_{it} \quad (15)$$

Where π_{it} is the observed twelve month CPI inflation rate; π_{it}^{*} is unobserved long-term average CPI inflation rate; parameter λ captures the weight attached to long-term inflation, e_{it} – disturbance term

Long-term average inflation is determined by:

$$\pi_{it}^{*} = \beta D_{it} + \alpha_i + \delta_t \quad (16)$$

D_{it} – IT regime dummy; α_i – country fixed effect; δ_t – time fixed effect

Combining equations (4) and (5) yields the following expression:

$$\pi_{it} = \lambda\beta D_{it} + (1-\lambda)\pi_{it-1} + \lambda\alpha_i + \lambda\delta_t + e_{it} \quad (17)$$

They argue that since subtracting π_{it-1} from both sides arrives at BS specification (if two period case is considered), then the equation (17) can be used as a regression equation. They agree with BS`s idea of IT dummy`s endogeneity and argue that instrumental variables can be used to deal with this issue. They use lagged IT dummy and initial inflation as instruments and run fixed effect estimation, controlling for country-specific and time-specific effects. They also run OLS estimations, however, the result are not reported here due to endogeneity of IT.
Examining the success in reduction of the inflation rate, MS contrast the performance of inflation targeters with different controls groups: non-targeters and pre-targeters; non-targeters; pre-targeters. They find strong evidence of reduced inflation when the compare performance of ITers only with pre-targeters (by 0.49 pp per year and long-run annual inflation by 5 percent), little weaker but still statistically significant evidence that IT reduces mean inflation when non-targeters and pre-targeters are taken as control group (by 0.46 pp per year and long-run annual inflation by 4.8 pp), but no significant evidence when ITers are contrasted only with non-targeters. For non-targeters taken as a control group, the result seems less credible because employing fixed effect estimation is not possible due to perfect collinearity of country effects with inflation targeting.

When MS disaggregate data into industrial and emerging economies, they find that in industrial economies there is weakly significant inflation difference in favour of ITers. They also report strong evidence in favour of converging targeters.

But Ball (2010) argues that these results are not credible due to the choice of instrument. MS use lagged IT dummy as an instrument, motivating it arguing that the IT dummy is influenced by variables which are direct determinants of inflation, such as central bank independence and the fiscal surplus. Ball (2010) thinks that if these variables affect the IT dummy, they also affect lagged IT dummy. MS`s instrument is correlated with error term, making it invalid.

At the same time, MS do not provide information about the conducted moment conditions tests for the validity of employed instruments. But even if conducted they would not have enough power to detect the failure of moment conditions, since initial inflation and lagged IT dummy can be severely correlated and, henceforth, identify the same wrong estimate of the coefficient for IT.

3.3 Propensity Score Matching (evidence for industrial and developing economies)

Another approach to testing the impact of IT is constructed on the basis of propensity score matching to estimate effect of treatment. Vega & Winkelried (VW, 2005) work with a sample of 109 developed and developing countries jointly and find that inflation targeting significantly reduces the level and volatility of inflation both controlling for initial condition and not. They allow for different effects of IT in industrial and developing economies, but assume that equation that determines IT adoption is the same for both groups. They find that positive impact of inflation targeting is present for both groups with more strong effects for developing. However, Ball (2010) finds quite a few puzzles with VW (2005) results. First, he argues that variables in equation determining inflation targeting adoption might differ for two groups. Second, the result that "soft" IT reduce mean and volatility of inflation more than "fully-fledged" targeting even though it is a bigger shift from traditional policy. Third, the estimate for "soft IT" is around -3 pp. Most countries shifting from traditional policy would have negative inflation rates if they adopted soft IT.

Lin & Ye (2007) use similar methodology and find the impact of inflation targeting in industrial countries is not significant. By extending their own approach Lin & Ye (2009) analyzed a sample of 52 developing countries, and find that in developing countries IT reduces inflation (by approximately 3 pp) and its variability.

3.4 Emerging economies

Mishkin & Schmidt-Hebbel (2007) find very significant evidence that inflation targeting reduces mean inflation in emerging economies that IT reduces inflation by 0.8 pp per year and 7 pp in the long-term for the control group of both non-targeters and pre-targeters, but no significant evidence for non-targeters. The finding for the control group of non-targeters is less reliable since MS are unable to use panel data estimation with country fixed effects and have to rely on pooled IV. For critiques of their specification see above.

Batini & Laxton (BL, 2007) and Gonçalves & Salles (GS, 2008) apply the BS`s specification to test whether the adoption of IT affects inflation and output growth in emerging economies. They come to a conclusion that IT countries reduce average inflation (BL finds coefficient equal to -4.82 pp and GS finds it to be around -2.5 pp), inflation volatility (BL), and output growth volatility (GS) more than non-ITers.

However, their conclusions were challenged by Brito & Bystedt (BB, 2010).

BB consider:

$$y_{it} = ay_{it-1} + bIT_{it} + chigh_{it} + \delta_t + \eta_i + \nu_{it} \qquad (18)$$

Since when dealing with emerging economies the outlier problem is very severe, they transform dependent variable Y_{it} (measure of economic performance) into logarithmic form and create a variable $high_{it}$ – dummy variable, equal to one if in a country i inflation is higher than 0.4 (in natural logarithm).

There are some severe problems with estimating the equation (18), including endogeneity of IT_{it} and $high_{it}$; serial correlation due to significant impact of y_{it-1}; error component structure with ε_{it} including time and country specific fixed effects (δ_t and η_i respectively). Given the Bertrand`s critiques, BB argue that the dynamic panel bias problem can be solved

by estimations using two-step Difference-GMM by Arellano & Bond (1991) and System-GMM by Arellano & Bover (1995). BB find relatively weak evidence that the IT framework has reduced inflation in emerging economies, and, in contrast with previous researchers, such as BL, they emphasize that there is statistically significant negative relation between IT adoption and output growth. This is an interesting finding which confirms one of theoretical pitfalls of inflation targeting.

3.5 Conclusion on long-run IT impact

The existing literature has not yet found any response to some of Gertler`s (2005) critiques of BS (2003). He says that the authors` classification scheme is not sharp enough and emphasizes that one can only evaluate the impact of inflation targeting when there is a clear alternative monetary policy regime taken as a benchmark.

Besides, Gertler provides evidence that the difference between the monetary path followed by ITers and non-ITers may not be clear-cut. The reason is that some countries which did not commit to inflation targets officially followed "de-facto" inflation targeting. He argues that inclusion of members of European Monetary Union (EMU) into the control group of non-targeters might be not acceptable, since EMU followed a policy that is similar to inflation targeting. Besides, he argues that the evidence suggests that Federal Reserve during Volcker and Greenspan eras has acted as an implicit inflation targeter. Therefore, constructing "de-facto" classification might provide more reliable evidence on the performance of inflation targeting.

Overall, there are two strands of literature: one that finds significant positive effects of IT and second that finds no significant impact of inflation targeting. There are also conflicting conclusions for industrial and emerging economies. The discrepancy in results is mainly a consequence of considering heterogeneous samples as well as different methodology of research.

3.6 Vector Autoregression models in inflation targeting-related studies

There is lack of research on the effect of inflation targeting in mitigating shocks. Even less research is conducted in panel setting, so/ this section focuses on the analysis of VAR studies on individual inflation targeting countries.

Mishkin & Schmidt-Hebbel (2007) attempted to assess whether inflation targeters differ from nontargeters—and whether targeters differ pre- and post-targeting—in the response of inflation to shocks in oil prices and the exchange rate and the response of domestic interest rates to innovations in international interest rates. To test for differences, they adopt a comparative analysis of impulse response functions in different country samples, depending on whether a country has inflation targeting in place. Their VAR system contains the following six variables (in this order): international oil price, international interest rate, output gap, inflation, interest rate, and nominal exchange rate.

They find quite a few interesting results, e.g. oil price shock creates more short-term volatility in IT countries but is then more rapidly absorbed by the economy. But oil price specification omits ARCH and GARCH effects, potential non-linear response of macro fundamentals to oil price shocks. Inflation is less sensitive to exchange rate shocks in IT. Response to international interest rate shock does not depend on IT regime.

Dungey and Pagan (2008) is based on a seminal paper Dungey and Pagan (2000) which, to the author`s knowledge, first applied VAR to small open economy model within New Keynesian framework. They present a SVAR model of the Australian economy, which models macroeconomic outcomes as transitory deviations from a deterministic trend. First, they relate it to an emerging literature on New Keynesian Dynamic Stochastic General Equilibrium modeling of small open economies. Second, they allow for both transitory and permanent components in the series and show how this modification has an impact on the design of macroeconomic models. Develop 2 models: one model SVARX2000 (Structural VAR with exogenous components) where all variables modeled as stationary and H2007 model with not de-trended data with two cointegrating vectors in a VECM.

Vespignani (2013) analyses the industrial impacts of monetary shocks since the introduction of inflation targeting in Australia in 1990. These impacts are quantified by constructing a structural vector autoregressive model for a small open economy. He employs Structural VAR with exogenous components and shows that construction and manufacturing industries exhibit a significant reduction in gross value added after an unanticipated rise in the official cash rate. However, the finance and insurance industry, and the mining industry, seem to be unaffected by these shocks.

Hartmann and Roestel (2013) is a panel VAR study that provides cross-country evidence on interdependencies among inflation, output growth and respective uncertainties for the current era of low inflation policies. They attribute the extant empirical disagreement on these relations to the fact that long sampling periods and single economies are typically considered for analysis. In this study, VARX-MGARCH-M models are estimated for 34 developed and emerging economies and the time period of 1990–2010. They study average (Granger) causal effects by aggregating parameter estimates over economies. The cross sectional variation of estimates serves as a means to assess the robustness of empirical findings. Over the entire cross section, they find that both inflation and inflation uncertainty significantly reduce output growth. Economies with low inflation rates are particularly at risk to incur output losses from increasing inflation. They also find spillover effects among uncertainty variables, where the causal impact, if present, seems to point from the uncertainty in output to inflation uncertainty.

Krušec (2011) develop structural vector error-correction model with long-run restrictions from NK open economy model. This paper estimates the monetary transmission mechanisms in four inflation-targeting new EU members: the Czech Republic, Hungary, Slovakia, and Poland. They find that a restrictive monetary shock has a significant negative effect on the inflation rate in all the countries considered. In response to a one-percentage-point shock in the nominal interest rate, inflation falls by half to one percentage point and returns to steady state after four to six months. Therefore, inflation targeting is likely to be an effective strategy on these countries' way to join the European monetary union. The policy might also be a relevant option for future EU member states.

4. Data

This section consists of several parts. It introduces the characteristics and the sources of the included variables as well as familiarizes the reader with classifications of countries as well

as their monetary regimes. Then some stylized facts about the data are discussed with pointing out its limitations and problems in estimation caused by them.

In purposes of the research, the data is collected for industrial and emerging countries, with all other countries not considered. Country classification used follows Laurens et al (2006). The sample includes 59 countries, out of which 27 are advanced and 32 are emerging economies.

In our basic model, data on monetary regimes is divided into 2 categories: inflation targeting and other monetary regimes. The data on the dates of IT in effect are collected from the Handbook of Bank of England (2012) and there are some discrepancies with previous studies.

Countries, which never formally used inflation targeting as a monetary strategy (hereinafter non-IT countries) include: Argentina, Austria, Bulgaria, Belgium, China, Croatia, Cyprus, Denmark, Egypt, Estonia, France, Germany, Greece, India, Ireland, Italy, Japan, Jordan, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Morocco, Netherlands, Pakistan, Portugal, Russian Federation, Singapore, Slovenia, Switzerland, United States, Venezuela, Thailand, Hong Kong.

Countries, which have used IT (ITers) any time in the past include: Australia, Brazil, Canada, Chile, Czech Republic, Finland, Hungary, Iceland, Indonesia, Israel, Korea, Mexico, New Zealand, Norway, Peru, Philippines, Poland, Romania, Slovak Republic, South Africa, Spain, Sweden, Turkey, United Kingdom. Vast majority of the countries which ever adopted IT, remained to use it. Finland, Spain, and Slovak Republic constitute an exception since they later joined Euro area, giving up their own monetary policy.

The analysis is done based on data from 1980-2014, which is the period when all the major changes in the direction of inflation targeting have been made. Panel-VAR part uses quarterly data while difference-in-difference part uses annual data, which is subsequently averaged into 3-year windows. Such choice is motivated by methodological peculiarities because VAR in general are overparameterized systems and adding as much observations as possible is very important and dynamic panel difference-in-difference specification conversely loses power when the number of time-series observations increases.

The panel-VAR system includes the following variables: Brent crude oil price, US 3-month Libor rate, constant US dollar GDP growth, inflation measured as Consumer Price Inflation or alternative national key inflation indicator and if unavailable as GDP deflator, national share price indices, national exchange rate against the currency of reference to which their exchange rate exhibited lowest volatility over the period (following Levy-Yeyati and Sturzenegger, 2009), domestic policy rates or if unavailable domestic discount rates. The data on all the variables were collected from the from IMF`s International Financial Statistics, and where unavailable from Datastream (e.g. national exchange rate data). The system includes the key variables which in macro-finance literature regarded to be important for explaining short-run economic situation in the economy.

For the VAR part of the present paper due to the higher number of economic and financial variables, the quarterly data for not all the countries is available. In particular, Estonia, Latvia, Luxembourg, Pakistan, Slovak Republic and South Africa are excluded from the sample and some of the countries have only few observations to include into the analysis.

Therefore, for the VAR part there are 53 countries in the dataset, out of which 26 are advanced and 27 are emerging.

The data on inflation is difficult to work with because of cross-country heteroskedasticity and due to the fact that some emerging economies experienced incredibly high inflation rates until the mid-1990s. Following Gonsalves & Salles (2008), observations for the periods when inflation is higher than 50 percent annually are dropped. Such high inflation rates often occur due to some dramatic failures of monetary policy or in periods of high socio-political instability. Given that the goal of the research is to see whether inflation targeting performs better than alternative properly organized monetary regimes, inclusion of these periods would produce bias in favour of IT.

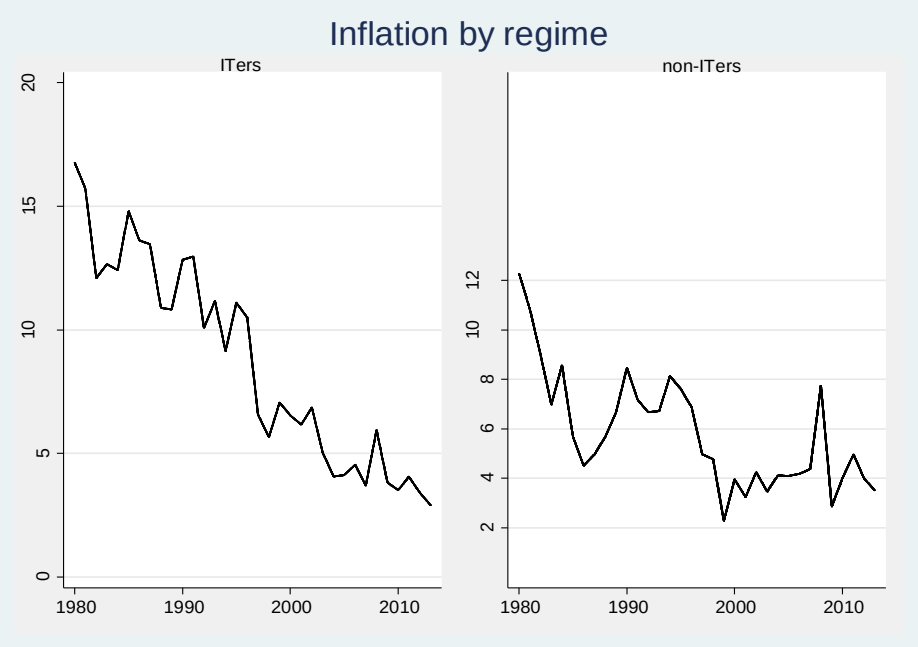


Fig1. Average inflation rates 1980-2014. On the left, the average inflation of countries that used inflation targeting as a monetary strategy. On the right, the average of countries that never used inflation targeting.

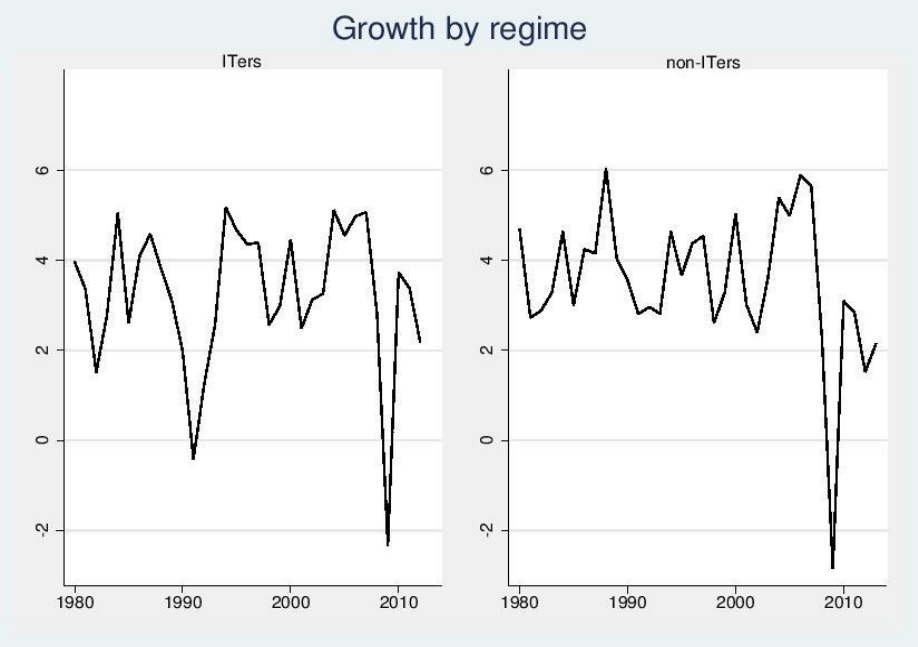


Fig2. Average output growth during 1980-2014. On the left the average inflation of countries that used inflation targeting as a monetary strategy. On the right, the average of countries that have never used inflation targeting.

There are several problems with figures 1 and 2. First, the dates of IT adoption differ across the countries. Second, Finland, Slovak Republic and Spain abandoned inflation targeting due to entering the Eurozone, but are still included into the sample of inflation targeters. However some general trends can be spotted with the inspection of Fig1 and Fig2.
Countries that have used inflation targeting reached greater reduction of the inflation rates and volatility. However to check the validity of these claim, it is important to take into account the potential endogeneity of inflation targeting choice. The group of inflation targeters started from initially higher level of inflation, so it can be argued that countries with high inflation rates adopted IT as a strategy to improve. As will be shown in further chapters it implies reverse causality problem for the specification. On Fig 2, it is difficult to see any relationship between the inflation targeting regime adoption and output growth dynamics. Overall, by inspecting the figures we are able to conclude that IT regime adoption has been mainly motivated by inflation rather than output concerns.

Following Gertler`s critiques, the author contrasts inflation targeting with exchange rate targeting, which is another clearly defined and relatively disciplined monetary strategy. The data on exchange rate regimes is collected from Reinhart & Rogoff (RR) archive. Both IMF official classification and RR`s de-facto coarse classification are used with exchange rate peg being defined as a country following regimes numbered 1 or 2 (details specified in appendix). The country is included into control group of exchange rate pegs if it followed regime 1 or 2 for at least 75% of the annual periods from 1980-2010. It should be noted that "75% criterion" is used only to make differences-in-differences specification sharper and better interpretable, but it is picked completely arbitrarily and its alteration would lead to a different result. For the VAR part, though, due to higher data frequency and rather different

methodology, all observations of exchange rate targeting are used to construct a control group.

According to RR classification exchange rate fixers: Austria, Belgium, Cyprus, Denmark, Finland, France, Hong Kong, India, Ireland, Luxembourg, Morocco, Netherlands, Pakistan, Portugal, Spain, Croatia, Estonia, Lithuania, Slovak Republic, Slovenia.

The detailed description of country classification as well as the dates of IT in effect can be found in the Table A.

5. Methodology

5.1 Differences-in-differences

Since the dating of the periods do not coincide across countries, time averaging (in Ball & Sheridan's way) leads to a substantial reduction of statistical power. First, as emphasized by Bertrand et al. (2003) serial correlation becomes a problem yielding dramatically higher rejection rate of the null hypotheses of no effect. Serial correlation tests conducted in this study confirm the existence of this problem. Second, although reverse causality is reduced in the specification owing to introduction of interaction terms, endogeneity cannot be eliminated in OLS framework due to omitted variable bias and measurement error issues (discussed in detail in results section).Third, in this setting not all information is used. Whereas first problem is resolved by estimation using cluster-robust variance-covariance estimator (consistent in presence of arbitrary heteroskedasticity and within-panel serial correlation), the existence of other problems points to using a different methodology.

The approach used to evaluate the inflation targeting impact involves the estimation using dynamic panel methodology.

$$y_{it} = \alpha y_{it-1} + \beta IT_{it} + \delta_t + \eta_i + \upsilon_{it} \qquad (19)$$

Where y_{it} is a macroeconomic performance indicator of interest (inflation rate, output growth, inflation volatility or output growth volatility); the subscript i =1, 2…N is the country. The lagged variable y_{it-1} is included to control for the persistence of the process and to capture the persistence of the process and the phenomenon of "mean-reversion", which implies that the dependent variable sample is reduced by one period. So t indicates time period: t=3, 4...T. The variable of interest is IT_{it} dummy, which takes value 1 a country i is an inflation targeter in period t and 0 otherwise. The term δ_t accounts for time effects, which arise due to common shocks affecting all countries in the sample. η_i allows for country-specific effects, and υ_{it} is an error term. Main problems with estimation of the equation (19) are:

1) The process is dynamic and current realizations depend on the past ones.
2) Error term structure including country fixed effects. Time-invariant country characteristics can be correlated with the regressors.
3) Endogeneity of IT dummy due to omitted variable bias, reverse causality and measurement error (discussed in the results section);
4) Idiosyncratic term υ_{it} might have specific patterns of heteroskedasticity and serial correlation

The problems of OLS and fixed effects are discussed in the results section. According to Mishkin and Schmidt-Hebbel (2007), there is no proper instrument for IT dummy. It is also very difficult to come up with plausible instruments for the lagged explanatory variable. So the only available instruments are lagged transformations of the variables.

Arellano & Bond (1991) proposed difference-GMM estimation, which is designed for samples with large N and small T and solves dynamic panel bias.

The idea of D-GMM involves differencing the equation (19), which deals with problem 2:

$$\Delta y_{it} = \alpha \Delta y_{it-1} + \beta \Delta IT_{it} + \Delta \delta_t + \Delta \upsilon_{it} \quad (20)$$

It is obvious that country specific effect disappears in this setting, but Δy_{it-1} is necessarily correlated with $\Delta \upsilon_{it}$ through y_{it-1} and υ_{it-1} terms. Besides since IT dummy is assumed to be weakly exogenous, and after transformation it also becomes endogenous since $E(\Delta IT_{it} \Delta \upsilon_{it}) \neq 0$. D-GMM internally instruments Δy_{it-1} and ΔIT_{it} with their lagged values. (Alternatively, orthogonal deviations rather than differencing can be used for transforming the equation (19). This is not discussed because orthogonal deviations are not used here)

To increase efficiency system-GMM proposed by Arellano & Bover (1995) involves forming a system of simultaneous equations. Apart from using D-GMM moment conditions, it makes use of additional orthogonality conditions, which arise from the equation in levels. The idea involves using differenced lagged instruments for the equation (19). Refer to the results section for more detailed discussion discussion.

It is commonly recognized that too many instruments can severely bias the results of D-GMM and S-GMM, and the rule of thumb suggests that number of instruments should not exceed the number of groups (N). Following this rule, in line with BB (2010) the data is summed up over usually three-year time periods and T=34 is reduced to T=11. The precise dating of the periods differs across countries depending on the date of IT adoption. If initially the country adopts inflation targeting in the middle of the period, the period can be extended or compressed so that during the period country uses only one definite type of monetary regime. Then collapsing the columns of instrument matrix into a column helps to reduce the number of instruments. It creates one instrument for each variable and lag distance rather than for each time period. When N$\rightarrow \infty$ such data manipulations reduce efficiency, but in small samples it helps avoid the bias due to the big number of instruments. Moreover these manipulations allow to exploit more information, which is contained in deeper lags of the regressors.

According to Roodman (2009, a), D-GMM and S-GMM standard errors can be substantially downward biased. Windmeijer (2005) also argued that two-step efficient GMM estimation performs better than one-step efficient GMM producing smaller bias in estimated coefficients and standard errors. Throughout the study, employing D-GMM and S-GMM involves using the Windmeijer's (2005) finite-sample correction to the standard errors in two-step estimation.
In the results section, to check the assumptions of no serial correlation in the idiosyncratic error term, validity of the instruments several tests are reported. First, the p-values of AR (1) and AR (2) tests for the equation in differences are reported. As will be discussed, AR (1) test is by itself not important, but the rejection the null hypotheses under AR (2) test will provide

evidence against the validity of specification. Second, Sargan and Hansen J tests as tests of over-identifying restrictions are reported. Sargan test is not robust to the failure of homoskedasticity and independence assumptions (e.g. it is not distributed chi-square in presence of heteroskedasticity), but not weakened by many instruments. Hansen J test is robust but loses power when the number of instruments climbs close to the number of groups. Considering the data transformations described above, Hansen J test tends to be more interesting in our specification. Rejection of the null will provide evidence against the validity of instruments, and, in fact, as argued by Roodman (2009, b) any p-value below 0.25 has to be taken with caution**.** Third, difference-in-Hansen test for additional moment conditions employed by S-GMM is reported. Rejection of the null for this test provides evidence that the instruments for the equation in levels do not hold and $E(\Delta z_{it-1}\eta_i)$=0 is not satisfied.
The robustness check employs specification under (19) and checks how the variation in the control group influences the result.

5.2 Bayesian Panel Vector Autoregression

VARs were popularized by Sims (1980) as natural generalizations of univariate AR models and as an alternative to large-scale simultaneous equation structural models. They proved to be especially useful when there is little theoretical information about the relationships among the variables to guide the specification of the model. VARs are designed to explicitly address the endogeneity problem, which is one of the most serious challenges of the empirical research on inflation targeting. Without imposing unnecessary restrictions, VARs help to alleviate the endogeneity problem through treating all variables as potentially endogenous and explicitly modelling the feedback loops among the variables. Third, the impulse response functions based on VARs can register any delayed impacts on (and of) the variables under consideration; these dynamic effects would not have been recorded by panel regressions. Fourth, panel VARs allow to include country fixed effects, which capture time-invariant components, such as openness of the economy or its monetary regime, and global time effects, which affect all countries in the same period. Finally, panel VARs can be effectively employed with relatively short time-series dimension due to the efficiency gained from the cross-sectional dimension.

In order to identify the impact of inflation targeting in weathering shocks in the national economy this study employs Bayesian Panel Vector Autoregression. This approach combines a traditional VAR approach with panel data and allows exploiting rich data set and getting efficiency in estimation. Then the sampling uncertainty and overfitting are reduced by imposing parameter restrictions on VAR coefficients with varying degrees of prior beliefs by specifying conjugate priors (in this study Minnesota priors developed by Litterman (1980) and Doan, Litterman, and Sims (1984) are used (for more thorough treatment see e.g. Sims and Zha, 1998 and Koops and Korobilis, 2010).

In an unrestricted Panel VAR specification: Let y_{it} denote a GX1 vector of macroeconomic variables for country (i = 1,…,N) at time (t=1,…T) and $Y_t = (y'_{1t}, \dots, y'_{Nt})'$. A reduced form VAR for country i may be written as:

$$y_{it} = \sum_{j=1}^{N} A_{ij}(L) Y_{t-1} + e_{it}, \qquad (21)$$

A_{ij} are GXG matrices for each i,j=1,2…N and e_{it} is GX1 vector of random disturbances. There are 2 lags for each of equations. e_{it} ~ N$(0, \sum_{ii})$ which is normal distribution with mean 0 and covariance matrix between the errors of countries i and j $\sum_{ii}$ of dimension GXG , The model assumes that there are p lags for each of the G endogenous variables, cross-unit lagged interdependencies exist whenever the matrix D_t(L)≠ J ⊗ D_{it} (L)for some L and where J is a 1 × N vector with one in the i-th position and zero elsewhere. In total, such system contains N^2G^2L coefficients, which is potentially a huge number.

Dealing with an unrestricted Panel VARs is hard due to its extreme overparameterization and a researcher needs to impose restrictions on the structure of the data. In order to infer about the effect of inflation targeting, we need to pool some countries into the groups of IT and non-IT countries. This can be done by imposing the restriction that the underlying structure is the same for each country. This constraint is unlikely to hold in practice, but it is possible to partially overcome it by allowing for "individual heterogeneity" by introducing fixed effects, denoted by f_i in the model. Also, it is assumed that one country's lagged variables do not affect another country's variable, which means that dynamic interdependencies are also assumed away. Therefore, the estimated model simplifies to:

$$Y_{it} = A(L)Y_{i,t-1} + f_i + e_{it}$$

The VAR system includes the following variables: oil price (Brent), national stock market index, nominal exchange rate (against US dollar, German mark, ECU or Euro depending on the lowest volatility value or data availability), output growth, international interest rate, domestic interest rate, CPI inflation, industrial production. The variables are picked either because of their importance in describing economic conditions or to catch up with the particular type of shock.

Reduced form VARs despite their extreme importance for forecasting, do not allow to draw inferences about economic interrelationships amongst the variables in the system. In order to derive impulse response function and other interesting economic patterns, it is necessary to impose more structure on the system. That is because the residuals (forecasting errors) are generally correlated, but shocking one equation makes sense only if other equations are unaffected. However, there are some technical issues concerning the possibility to recover structural form VAR. Consider structural form of the PVAR:

$$By_{it} = \Omega_i + \mathbb{\Gamma}(L)Y_{i,t-1} + \varepsilon_{it}, \qquad (22)$$

where ε_{it} are uncorrelated across equations for G endogenous variables;

B is a matrix of coefficients for contemporaneous terms in VAR $\begin{pmatrix} 1 & \cdots & b_{1g} \\ \vdots & \ddots & \vdots \\ b_{g1} & \cdots & 1 \end{pmatrix}$

The covariance matrix $\sum_{ii}$ is symmetric and contains only $(g^2 + g)/2$ distinct elements. Given that diagonal elements of B are ones there are $(g^2 - g)$ distinct elements in B and g unknown values in $var(\varepsilon_{it})$. Henceforth, the problem lies in the fact that we need to recover g^2 elements from only $(g^2 + g)/2$ known parameters. In order to recover additional $(g^2 - g)/2$ some structure either on the variance of ε_{it} or on matrix B. However, it is common to restrict coefficients of B and researchers practice various approaches to identification.

In order to identify structural innovations and evaluate the economic relationships in the system, the present paper makes use of recursive Cholesky structural decomposition. The identifying assumption of recursive ordering is that the variables that come earlier in the ordering affects all the following variables contemporaneously, while the variables that come later affect the previous variables only with a lag. The fast-moving variables, which are usually priced at financial markets come into the system before slow-moving. For the decision on which variables might be assumed to be causally prior within those categories Granger-causality tests are used. It is worth noting, though, that the system is quite robust to changing the ordering of the variables.

The VAR system is estimated in levels following Sims (1980) and Stock and Watson (1996) who recommended against the differencing even if the variables contain a unit root. Their argument was based on the idea that the objective of VAR analysis is to determine the interrelationships amongst the variables rather than to determine parameter estimates. Intuitively, this is undesirable to difference since it, essentially, "throws away" information. As argued by Ashley and Verbrugge (2009) even in the presence of cointegration estimating VAR in levels generates impulse responses robust to specification issues. Such arguments are even more coherent when using structural VARs. So the transformations of the variables are primarily motivated by outlier and cross-country heteroscedasticity concerns.

So in order to prevent the results to be biased by a small number of observations with extreme values, for methodological consistency all stationary variables X_{it} are transformed into:

$$x_{it} = 100 * \ln(1 + \frac{X_{it}}{100}) \quad (23)$$

All variables W_{it} containing unit root are transformed into:

$$w_{it} = \mathrm{HP}(\ln(W_{it})) \quad (24)$$

Where HP denotes deviations from Hodrick-Prescott trend.[1]

The large number of parameters makes a Panel-VAR very flexible. Nevertheless, the overparameterization may lead to an overfitting problem, especially in macroeconomic applications, where time series are often characterized by a limited number of observations and exploding variances. Bayesian inference in VAR context has a long tradition. As already mentioned, panel VAR models include many free parameters to accommodate for cross-correlations amongst the variables and serial correlation. Therefore, estimation of VAR with non-informative (flat) priors may lead to in-sample overfitting, which implies poor out-sample forecasting performance as well as biased impulse response functions. So VARs with flat priors treat initial observations as non-random. The main disadvantage of models estimated with non-informative priors is that they attribute and an implausibly large proportion of variation to deterministic components. It is possible to alleviate the problem by formulating such priors that would express the disbelief in an excessive explanatory power of deterministic component. Informative priors help the researcher shrink overparameterized unrestricted model to a parsimonious benchmark, which results in reduced estimation uncertainty.

The system contains 59 heterogeneous countries differing in the level of economic development, the model of policy making, exchange rate regimes, financial market penetration etc. As shown by Korobilis (2015), treating panel VAR without explicit cluster structure (in a sense that coefficients

[1] The coefficient used in all HP-filtered trends used here is standard value used for quarterly data λ=1600

do not share common locations) as a large VAR using e.g. Minnesota priors allows overcoming estimation uncertainty.

Minnesota prior involves replacing $\sum_{ii}$ with of an estimate assuming it to be a diagonal matrix. So, each equation of the VAR can be estimated one at a time. Since $\sum_{ii}$ is replaced by an estimate, the prior is only specified for elements of $A_{it}(L)$.

The Minnesota prior involves setting most or all prior means to zero (thus shrinking the parametrization of VAR) and assuming simple diagonal structure for the prior variance. However, for the levels data the Minnesota prior would assume that individual time series can be a-priori represented as random walks. So, for our setting the mean for all the parametrizations of autoregressive matrix is zero, except for the elements corresponding to the first own lag of the dependent variable in each equation. Those have been usually set to one, but we set it to 0.9, in line with empirical exposition of Koop and Korobilis (2010), to express the prior belief that the variables exhibit substantial persistence but not unit root. At the same time, a posteriori each time series will follow a more complicated process if there is sufficient evidence in the data. Besides specifying hyperparameter controlling for the overall tightness of the prior offers a parsimonious way of introducing plausible correlations between the parameters of the model. For precise definitions of moments implied by Minnesota prior refer to Gianonne, Lenza and Primizeri (2012).

Main advantages of Minnesota prior, which makes it probably the most popular in the empirical literature, are that it is relatively easy to implement either by dummy observations or by directly specifying prior distribution and that the posterior inference is simple and relies solely on Normal distribution. This simplifies analysis and allows deriving analytical solution, but a disadvantage is that Minnesota prior does not provide full treatment for $\sum_{ii}$, ignoring uncertainty in this parameter.

6. Results

6.1 Long-run impact of inflation targeting

As discussed in methodology section, Bertrand et al. (2003) emphasized some pitfalls of time averaging in "differences-in-differences" estimation. Apart from that, endogeneity cannot be eliminated in setting given by the equation (12). There are some undisputable problems with OLS estimation due to omitted variable bias, which may arise due to omission of relevant variables (can be socio-political instability or some measure of corruption level across different countries). Measurement error can also be an issue since the data on GDP and inflation heavily depends on the methodology employed by the national statistical bureaus. Besides in some emerging countries there might be manipulations for political reasons. Since the sample (N=59) is relatively large it can be useful to analyze this result using dynamic panel data methodology.

Table 1 (more specifically sub-tables 1.1, 1.2, 1.3, 1.4) reports the results of running different versions of Equation (19).

$$y_{it} = \alpha y_{it-1} + \beta IT_{it} + \delta_t + \eta_i + \upsilon_{it} \qquad (19)$$

First column reports the results of OLS with time effects and second of FE estimation, allowing for time effects. Because of lagged explanatory variables, OLS is biased and inconsistent even if the υ_{it} are serially uncorrelated. This is because y_{it-1} is correlated with η_i.

Within group transformation transforms the variables as follows:

$$y^*_{it-1} = y_{it-1} - \left\{\frac{1}{T-2}\right\}(y_{i3} + \ldots + y_{iT}) \quad (25)$$

$$v^*_{it} = v_{it} - \left\{\frac{1}{T-2}\right\}(v_{i3} + \ldots + v_{iT}) \quad (26)$$

Dynamic panel bias cannot be eliminated in this fashion since the y_{it-1} term in y^*_{it-1} negatively correlated with $-\left\{\frac{1}{T-2}\right\}(v_{i3} + \ldots + v_{iT})$ FE estimator is biased but consistent for $T \to \infty$.

On top of that, it is not possible to overcome endogeneity of y^*_{it-1} with lags of y_{it-1} since they are part of the error term as well.

Reporting these results is useful, because according to Roodman (2009, a) the true coefficient must lie in the range between OLS and FE coefficients, which are biased in opposite directions.

Third column uses two-step D-GMM estimator in order to fix dynamic panel bias. Remember, the idea of D-GMM is in differencing the equation to expunge fixed effects and using lagged levels as instruments for endogenous regressors. The problem of differencing is that Δy_{it-1} becomes correlated with the error term $\Delta\upsilon_{it}$. Besides, all predetermined control variables (in this case IT dummy) become endogenous. D-GMM framework accounts for that instrumenting endogenous regressors with lagged levels.

Third columns of Table 2 considers IT dummy to be predetermined and uses D-GMM and during the estimation the following instruments are used:

For periods t≥3 $(y_{it-2-j},\ IT_{it-1-j})$ for j=0, 1….t-3

However, the coefficients: for inflation equation -3.06, for inflation volatility 0.087; for growth -1.72 do not fall into the range as well. Only the coefficient for growth volatility equation is credible.

In our case there are at least three reasons to prefer Blundell & Bond`s (1998) system GMM approach, which was first outlined by Arellano & Bover (1995). First, as demonstrated by Blundell and Bond (1998) if the y is a persistent process close to random walk, then D-GMM performs poorly because past levels do not convey much information about future changes, so past levels are weak instruments for current differenced variables. Second, BB (2010) pointed out that IT dummy is highly persistent variable, because IT=1 at t almost guarantees IT=1 at t+1, the same is true for IT=0. In such situation, levels of IT dummy are weak instruments for its changes. Third, Roodman (2009, a) argued that when unbalanced panel is used it is better to avoid using D-GMM since it has a property of magnifying the gaps.

Apart from transforming regressors into differences to get rid of fixed effect, S-GMM transforms the instruments into differences to make them orthogonal to fixed effects. For variables close to random walk past differences are more predictive about actual levels than reversely. However, for S-GMM to work $E(\Delta z_{it-1}\eta_i)=0$ must hold. According to Roodman (2009, a), this condition is likely to hold if the coefficients on lagged dependent variables and fixed effect offset each other. BB (2010) argues that this assumption is reasonable in the setting considered.

Fourth columns consider IT dummy to be predetermined and uses S-GMM with use of the following moment conditions:

For periods t≥3 (y_{it-2-j}, IT_{it-1-j}) with equation in differences for j=0, 1….t-3; and (Δy_{it-1}, ΔIT_{it}) for equation in levels.

BB (2010) emphasizes that treating IT dummy as predetermined usually makes sense since time and country effects are useful in removing reverse causality. However, it cannot solve the problem completely. Fifth columns take into account possible endogeneity of IT dummy and use the following moment conditions:

For periods t≥3 (y_{it-2-j}, IT_{it-2-j}) with equation in differences for j=0, 1….t-3; and (Δy_{it-1}, ΔIT_{it-1}) for equation in levels.

The results show that estimates obtained with S-GMM usually fall into the required range. Overall, controlling for endogeneity does not change the results dramatically. Very few results are robust. There is some evidence that IT reduces inflation volatility.

Overall, regressions using D-GMM and S-GMM show, that there is no significant evidence to conclude that choosing inflation targeting as a monetary policy strategy changes macroeconomic outcomes reflected in the behaviour of inflation and output growth.

In Table 1 the tests for autocorrelation aside from fixed effects are reported. Since $\Delta\upsilon_{it}$ and $\Delta\upsilon_{it-1}$ share the υ_{it-1} term, the presence of serial correlation in first differences is not surprising, and the result of AR (1) test does not convey any valuable information. Therefore to check first-order autocorrelation in levels, it is important to look at AR (2) test in differences. Rejection of the null hypothesis for this test shows, that υ_{it-1} and υ_{it-2} are correlated through $\Delta\upsilon_{it}$ and $\Delta\upsilon_{it-2}$. It would render y_{it-2} an inappropriate instrument for Δy_{it-1} and the researcher has to go further in specifying lags of instruments.

In the employed specifications, in line with the assumptions, the results suggest presence of first-order serial correlation and no second-order serial correlation. Therefore, the specification that includes 2 lags in regression specification works well.

The Hansen J tests of over-identifying restrictions do not reject the overall validity of instruments employed. Difference-in-Hansen tests for all specifications fail to reject the null hypothesis. This supports the models meaning that additional moment condition $E(\Delta y_{it-1}\eta_i) = 0$ holds. Problems of D-GMM and S-GMM include: although Hansen tests are robust to failure of homoskedasticity and independence assumptions, its statistical power is weakened by too many instruments. S-GMM and D-GMM perform very well for panels of large N and small T. In our case N=59, T=11 this assumption, although seems quite reasonable, is not completely valid and there might be some finite sample bias.

Robustness

This section describes the results of the robustness check regressions, which can be found in Tables (5-8). First, we contrast full treatment sample comprising all inflation targeting countries with all exchange rate fixers according to the de-facto Reinhart & Rogoff classification. Therefore, this paper addresses the critique of Gertler (2005), who pointed out that IT regime should be compared with another clearly defined alternative monetary framework. However, the only significant finding is that inflation targeting countries achieve greater increase (or smaller decrease) in economic growth rate.

Then, the entire sample is divided into emerging and advanced countries and using our dynamic panel data methodologies we try to see what the effects of IT treatment in both groups are as well as to check to what extent this disaggregation makes a difference.

Overall, considering both control groups there seems to be no significant evidence to conclude that inflation targeting countries performed better or worse than alternative monetary regimes. Therefore, the greater reduction in inflation during 1980-2014 might be attributed mostly to the endogeneity of the inflation targeting adoption, because IT countries are likely to have reached the greater reduction in inflation merely as a consequence of the mean reversion. However, empirical analysis also did not show any negative effects of inflation targeting, which shows that many theoretical assumptions against IT (e.g. suggesting that IT harms economic growth) are not valid. Even more, there is some marginally significant evidence that IT increases economic growth in advanced countries, possibly at some inflation cost. This might suggest that when the economy is under no risk of exceeding inflation target, the central banks in industrial countries might consider opportunities to foster economic growth bringing the inflation closer to the targeted level. It emphasizes the flexibility of inflation targeting as a framework rather than a rule.

6.2 Stabilization properties of inflation targeting

As discussed in the economic theory part, some researchers suggested that inflation targeting changes the short-run response of the economy to various types of shocks. For example, IT is assumed to perform relatively well in times of shocks to domestic expenditure, money demand, foreign asset prices or foreign exchange risk premium. On the other hand, its performance might be inferior to other regimes involving intermediate targets in times of domestic supply shocks since it attempts to decrease aggregate demand and maintain the inflation target, whilst other regimes allow for some shock absorbing.

The major goal of this chapter is to assess whether these conclusions are consistent with the empirical evidence. Inflation targeters are contrasted with other countries using flexible Bayesian Panel VAR approach and, then, I conduct the comparative analysis of the cumulative impulse responses of key economic variables to various shocks that may hit the economy. Each column of figures 1-12 in appendix summarizes the impulse response functions over 20 quarters to a standard deviation shock in a specific macroeconomic variable.

The impulse responses to oil price shocks

Within the entire sample of emerging and advanced economies, in inflation targeting countries economic growth falls less, stock market indexes and industrial production exhibit growth which is in sharp contrast with non-targeters. The fact that the cumulative impulse response difference in share prices following oil price shock is 10 percentage points, clearly suggests that inflation targeting helps building credibility amongst international investors, who seem to consider inflation targeting countries as a ‘safe haven’ where the policy makers are able to keep the economy under control when unexpected rise in oil price occurs. The inflation targeting policy makers indeed seem to act quite aggressively to counter the effect of soaring oil price by raising interest rates, which helps to almost offset the rise in inflation within 6-8 months after shock. Although initially increase in the interest rates leads to a 2 percentage point rise in the exchange rate, as soon as central bank loosens its policy, exchange rate stabilizes.

At the same time, inflation jumps more in the inflation targeting countries (by almost 1 percentage points over the course of 20 quarters), which is in line with Friedman and Kuttner (1996) who argued for the treatment of inflation targeting as a rule. However, it might be simply the result of rising stock market and liquidity inflow into the IT countries. The fact that non-ITers actually face deflation upon the oil price shock also supports this argument since with such dropdown in financial market credit and money could be under significant pressure.

Therefore, it is quite clear that inflation targeting central bank indeed succeed more in stabilizing the economy when the economy is hit by oil price shock. The findings are quite robust to data disaggregation and are even sharper when advanced economies are considered. Inflation targeting performs a bit worse within the sample of emerging economies since it turns out that economic growth slows down by approximately 1 percentage point after an initial "speculative" jump. Although there is evidence arguing that the emerging IT countries face a strong increase in the stock market, the central bank is less efficient in preventing exchange rate appreciation.

The impulse responses to international interest rate shocks

The response of domestic interest rates to a shock in the international interest rate (3-month USD LIBOR) is quite substantial and rises over time and is similar in both IT and non-IT countries. The notable difference is that ITers' exchange rates appreciate while non-ITers' currencies depreciate and the difference peaks near 4-5 quarter reaching 1.5 percentage points.

It is striking to note the huge and persistent rise in national share price indexes for both groups. One interpretation lies in the fact that yields for US bonds are strongly positively correlated with LIBOR rate. A positive shock to LIBOR might lead to the devaluation of bonds, which suggests that investors are looking for more risky and thus profitable investments. Another interpretation may be that policy makers make their decisions in a forward-looking manner, so that they might increase interest pre-emptively when they anticipate boom both in the financial and real sector.

Economic growth increases less in inflation targeting countries. Impact on inflation in contrast to non-ITers is positive after 6 quarters after the shock. This is probably the consequence of a smaller rise in interest rate. However, the results for industrial production and growth are not robust to the variation in the control group, holding only for the advanced sample.

Thus in the times of foreign risk premium shocks such as an increase in LIBOR rate, inflation targeters do not perform significantly better than non-targeters. At the same time, there is some evidence that exchange rate absorbs the shock and reduces the volatility of economic growth.

The impulse responses to domestic asset price shocks

One standard deviation positive shock in the domestic stock market index generates a strong and persistent bullish trend which is in line with many investment strategies. Investors willing to invest into a country's shares increase their demand for the issuing currency which results in a positive response of exchange rate peaking at about 1 percentage point after 6 quarters following the shock.

The boom in the financial market leads to the increase in economic growth, showing more than 2 percentage points growth around 4-5 quarter. This in turn leads to a persistent rise in inflation,

which central bank seeks to overcome by raising the interest rate. However, the monetary contraction in non-IT countries does not seem to be consistent with Taylor rule, so inflation keeps accelerating over the entire period of 20 quarters. The inflation-targeting central banks, in contrast, seem to respond more than 1 to 1 to inflation, so as a result inflation stops increasing after about 10 quarters following the shock. So, the IT central banks better stabilize the economy since they effectively manage to close the positive output gap.

The impulse responses to exchange rate shocks

One standard deviation positive shock in the national exchange rate against anchor currency also results in a big trend of appreciation in all subsamples of countries, amounting on average to approximately 10 percentage point in cumulative response.

Exchange rate appreciation leads to an increase in the demand for imported goods and export might be under significant pressure, so economic growth registers although delayed but notable decline. Inflation targeters both in the advanced and emerging samples use much less austerity in the monetary policy conduct.

Advanced ITers in contrast experience capital inflow into stock markets while all other countries entered the bear market following the exchange rate appreciation. They also do not suffer from the decline in economic growth or from the soaring inflation volatility. Thus, investors seem to believe that the IT central banks manage to keep control over the economic situation. Emerging ITers, however, face a reduction in share prices and economic activity similarly to the non-IT countries. This could be due to the fact that the central banks fail to convince investors in their ability to prevent deflation in the economy.

Therefore, it is evident that a successful short-run stabilization can be achieved only if inflation targeting is used by a developed economy. It might be because policy makers in emerging economies even using IT do not have enough credibility or instruments to communicate to the public that they are able to cope with exchange rate shocks. This is consistent with Bernanke, Laubach, Mishkin, Posen (1999) who argued that there is no evidence that the introduction of inflation targets by itself anchors inflation expectations, which is proved both by surveys and by the level of long-term nominal interest rates. Inflation expectations usually came down as inflation-targeting central banks clearly demonstrated that they can achieve and keep low inflation.

The impulse responses to economic growth shocks

Following the positive shock to the economic growth, monetary policy in inflation targeting countries is somewhat tighter than in other countries, with the difference in interest rate ranging from 0.2-1 percentage points.

Owing to the tighter monetary policy and better-anchored expectations, ITers manage to smooth the inflation path by about 2 percentage points. Of course, there is some output cost as well as a less significant rise in share prices. However, from the welfare point of view such stabilization definitely favours inflation targeters.

Data disaggregation shows that if IT is used by an advanced economy, monetary policy achieves credibility and anchors expectations to the extent that tighter policy might be not required. Therefore, if developed economy applies IT and its policy makers have shown their ability to maintain low inflation, the trade-off between output and inflation could be improved, in other words, monetary policy almost eliminates "inflation bias".

The impulse responses to inflation shocks

There is clear evidence suggesting that one standard deviation shock in inflation striking the economy seems to be interpreted by the public that inflation targeting central banks are unable to maintain inflation low which in turn generates capital flight and panic in the real sector. So, ITers face a significant downturn in both real activity and in the stock market. The Inflation-targeting central banks are unable to cope with the shock by sufficiently raising interest rates due to the fear of pushing the economy into an even deeper recession, so their interest rates respond to inflation significantly less than other countries. At the same time, exchange rates of inflation targeting countries appreciate while all other countries devaluate their currencies following inflation shock. As a result, inflation is less significant and protracted than in other countries with difference reaching more than 5 percentage points. This model of macroeconomic transmission seems to hold for both advanced and emerging economies.

This is consistent with the treatment of inflation targeting as a framework rather than a rule. It is clear that the inflation targeting central banks put weight on output stabilization (lambda significantly different from zero in policy objective eq(1)) and are able to make judgmental adjustments when they face unexpected volatility in the economy.

The impulse responses to a monetary policy shocks

An unexpected increase in the policy interest rate or monetary contraction results in a persistent stock market decline and exchange rate depreciation. Although the effect holds for both ITers and non-ITers, the volatility of the response is considerably smaller within the inflation targeting sample.

Combination of higher liquidity in the bond markets, relative stability in the economy with commitment to control inflation and higher interest rates seems to attract investors in the government and corporate bonds of the advanced inflation-targeting countries, which results in significant exchange rate appreciation. Emerging ITers experience delayed by about 7-8 quarters appreciation largely due to slightly rising inflation as well as smaller levels of development and liquidity in the national bond markets. Non-ITers experience depreciation following monetary contraction due to economic instability and surging inflation.

Exchange rate depreciation might be a reason why non-IT countries seem to be unable to generate short-term inflation decline by raising interest rates. However, even advanced ITers manage to deflate only after a slight increase in inflation lasting for about 3 quarters. In the VAR literature, an inconsistent with standard economic theory inflation response is commonly referred to as the "price puzzle". Various studies give conflicting interpretations of this phenomenon. Sims (1992) interpreted price puzzle as a consequence of imperfectly controlling for information that the central

banks may have about future inflation. Bernanke et al. (2004) argued that to the extent that VAR system lacks information that the central banks and private sector may have, the measurement of policy is likely to be contaminated. Secondly, VAR systems typically include few variables compared to what central banks care about due to parametrization and data availability concerns. So, Bernanke et al. (2004) proposed Factor-Augmented Vector Autoregression, which essentially relies on collecting as much data as possible, and then the collected variables are converted into factors which are, in turn, used as variables in the system. However, FAVARs might be of less use in a multicounty framework since countries differ in the degree of data availability and in the standards of statistic reporting.

However, despite the specification problems mentioned, Bayesian Panel VAR approach still allows to conclude that following the contractionary shock the central banks in the non-IT countries fail to communicate to the public that they are able to stabilize the economy while inflation targeting definitely helps to anchor expectations and build credibility. Moreover, effects of IT are even stronger as the central banks manage to persuade the public that they are able to maintain their inflation targets.

Robustness

Following Gertler (2005), who argued that inferences on effects of inflation targeting only make sense if IT is contrasted with another well-defined monetary framework, inflation targeters are compared with exchange rate fixers (pegs) under Reinhart & Rogoff de-facto classification. Figure 4 shows impulse response functions for the exchange rate targeters, and figure 5 presents the difference between the response of ITers and pegs.

In general, the inferences drawn from the comparison of inflation targeting countries to all other countries apply to exchange rate targeters with at most two differences that are worth mentioning.

First, the positive response of inflation to oil price shock is more persistent when contrasted against pegs than against Non-IT countries in general. ITers experience smaller inflation rise following oil price shock than pegs. This is in line with Mishkin and Schmidt-Hebbel (2007) and Bernanke, Laubach, Mishkin, Posen (1999) who argued for the treatment of inflation targeting as a framework rather than a rule. According to them, if it was to be treated as a rule it would susceptible to criticism for the performance during domestic supply shocks such oil price increase. But if IT is treated as a framework, the policy makers successfully anchor inflation expectations so the public is confident in their ability to maintain low inflation.

Second, unlike in other non-IT countries the expectations regarding national exchange rate are better anchored in pegs so they do not to raise interest rates that significantly. At the same time, pegs do not experience economic growth acceleration as in the non-IT countries. It might be due to depreciation effects and increase industrial competitiveness in the latter group.

7. Conclusion

According to Roger (2010), inflation targeting is seen by many as a monetary policy integrating major guiding principles for a monetary policy framework. This is, probably, the main reason for the widespread adoption of IT over the recent decades. Now, more than twenty years have passed after New Zealand pioneered in adoption of inflation targeting and, as of 2012, 27 countries are using IT as a monetary strategy. Extensive availability of the economic statistics drives the author of the present to check whether theoretical assumptions about inflation targeting are robust empirically.

In order to see whether inflation targeting improves the performance of countries implementing it in the long-run as suggested by many of the existing studies, this study analyses the influence of inflation targeting on the levels and volatilities of inflation and output growth. This study applies D-GMM and S-GMM to identify the impact of inflation targeting on the economic performance of the treatment group. The findings of this paper seem to be robust since the specifications control for common fixed and time effects, various regression to mean effects and endogeneity of IT adoption.

Estimation of equation (19) for the entire sample showed that the evidence that IT reduces inflation level and volatility is not statistically significant, which is in line with Ball (2010) but in contrast to many other studies. The evidence on growth rate level and volatility also does not appear to be significant. However, after the disaggregation of the sample into industrial and emerging countries, the findings for the entire sample did not prove to be robust. For example, there is some statistically significant evidence that IT reduces inflation volatility in emerging countries. Additionally, there is some marginally significant evidence that IT increases economic growth in advanced countries, possibly at some inflation cost. This might suggest that when the economy is under no risk of exceeding inflation target central banks in industrial countries consider opportunities to foster economic growth bringing the inflation closer to targeted level.

There seems to be no impact attributed to IT in the industrial countries and weak evidence in the sample of emerging economies. Besides, the comparison of IT with exchange rate targeters did not produce any significant results. Overall, there seems to be no significant evidence to conclude that inflation targeting countries performed any different compared with the alternative monetary regimes and the greater reduction in inflation shown on the figure 1 (page 21) during 1980-2014 is attributed mostly to the endogeneity of the inflation targeting adoption.

Estimation of equation (21) using Bayesian panel-VAR approach produces evidence on short-run shock mitigating properties of inflation targeting. Overall, the results suggest that inflation targeting indeed helps building credibility of the central bank. And, although, there are some stabilization issues with IT during domestic supply shocks, e.g. during oil price and inflation shocks, the economic benefits of inflation targeting clearly outweigh its costs. For example, its performance seems to be superior in times of asset price, economic growth and monetary policy shocks. Moreover, the positive effects of IT are even stronger as the public is confident in the ability of the central banks to maintain their inflation targets, which seems to be the case in industrial countries.

It is important to understand, that empirical analysis did not show any negative effects of inflation targeting, which shows that many theoretical assumptions against IT are not valid. From a policy standpoint, IT can still remain popular, being attractive for many emerging countries since it offers

more transparency, flexibility, puts pressure on the central bank to commit to the announced target and does not harm economic growth.

Going forward, there might still be some scope for future research. First, as pointed out by Gertler (2005), the difference between the monetary path followed by ITers and non-ITers may be not so sharp. The reason is that some countries that did not commit to inflation targets de-jure, followed monetary policy implicitly very close to inflation targeting (e.g. United States, ECB). Constructing a "de-facto" classification can provide more reliable evidence on the performance of inflation targeting. Second, it can be quite interesting to test the theoretical assumption that IT increases exchange rate variability, excluding exchange rate fixers from the control group.

8. Appendix

Table 1.1 Results of estimating the inflation equation.

	TE	CTE	DGMM_P	SGMM_P	SGMM_EN
	b/se	b/se	b/se	b/se	b/se
L.Inflation	0.671***	0.421***	0.543***	0.500***	0.502***
	(0.02)	(0.03)	(0.09)	(0.08)	(0.08)
IT	**-0.531**	**-2.162*** **	**-0.618**	**-0.658**	**-0.541**
	(0.45)	**(0.62)**	**(2.32)**	**(0.42)**	**(0.51)**
AR(1) test			0.003	0.002	0.002
AR(2) test			0.422	0.419	0.421
Sargan test			0.648	0.065	0.047
Hansen J test			0.413	0.314	0.410
Difference-in-Hansen				0.171	0.124
Number of instruments			25	28	27
R-sqr	0.813	0.496			
N_of_obs	519	519	457	519	519
* p<0.10, ** p<0.05, ***p<0.01					

Standard errors in parentheses; 3 stars indicate statistical significance at 1% level; 2 stars show significance at 5% level; 1 star declares statistical significance at 10% level. For AR (1), AR (2) and Hansen J test p values are reported. DGMM_P and SGMM_P treat IT dummy as predetermined. SGMM_EN treats IT dummy as endogenous. Windmeijer's (2005) standard errors are used for each D-GMM and S-GMM estimation. Period dummies are not reported.

Table 1.2 Results of estimating the inflation volatility equation.

	TE	CTE	DGMM_P	SGMM_P	SGMM_EN
	b/se	b/se	b/se	b/se	b/se
L.Inflation_Volatility	0.334***	-0.026	0.084	0.205	0.205
	(0.03)	(0.04)	(0.07)	(0.12)	(0.12)
IT	**-0.247**	**-1.040*** **	**-1.236**	**-0.203**	**-0.155**
	(0.26)	**(0.33)**	**(3.51)**	**(0.16)**	**(0.17)**
AR(1) test			0.005	0.007	0.008
AR(2) test			0.261	0.232	0.232
Sargan test			0.004	0.000	0.000
Hansen J test			0.381	0.280	0.325
Difference-in-Hansen				0.092	0.233
Number of instruments			25	28	27
R-sqr	0.521	0.152			
N_of_obs	513	513	450	513	513
* p<0.10, ** p<0.05, ***p<0.01					

Standard errors in parentheses; 3 stars indicate statistical significance at 1% level; 2 stars show significance at 5% level; 1 star declares statistical significance at 10% level. For AR (1), AR (2) and Hansen J test p values are reported. DGMM_P and SGMM_P treat IT dummy as predetermined. SGMM_EN treats IT dummy as endogenous. Windmeijer's (2005) standard errors are used for each D-GMM and S-GMM estimation. Period dummies are not reported.

Table 1.3 Results of estimating the growth equation.

	TE	CTE	DGMM_P	SGMM_P	SGMM_EN
	b/se	b/se	b/se	b/se	b/se
L.growth	0.332***	0.175***	0.359***	0.296***	0.295***
	(0.03)	(0.04)	(0.08)	(0.06)	(0.06)
IT	**-0.103**	**0.477**	**-1.030**	**0.612**	**0.639**
	(0.27)	**(0.46)**	**(1.95)**	**(0.40)**	**(0.48)**
AR(1) test			0.000	0.000	0.000
AR(2) test			0.598	0.662	0.664
Sargan test			0.993	0.839	0.815
Hansen J test			0.639	0.456	0.523
Difference-in-Hansen				0.090	0.189
Number of instruments			25	28	27
R-sqr	0.783	0.161			
N_of_obs	492	539	477	539	539
* p<0.10, ** p<0.05, ***p<0.01					

Standard errors in parentheses; 3 stars indicate statistical significance at 1% level; 2 stars show significance at 5% level; 1 star declares statistical significance at 10% level. For AR (1), AR (2) and Hansen J test p values are reported. DGMM_P and SGMM_P treat IT dummy as predetermined. SGMM_EN treats IT dummy as endogenous. Windmeijer's (2005) standard errors are used for each D-GMM and S-GMM estimation. Period dummies are not reported.

Table 1.4: Results of estimating the growth volatility equation.

	TE	CTE	DGMM_P	SGMM_P	SGMM_EN
	b/se	b/se	b/se	b/se	b/se
L.Growth_volatility	0.292***	0.026	0.106	0.143**	0.142**
	(0.04)	(0.05)	(0.08)	(0.06)	(0.06)
IT	**-0.379***	**-0.235**	**-0.347**	**-0.384**	**-0.290**
	(0.21)	(0.30)	(1.45)	(0.26)	(0.26)
AR(1) test			0.000	0.000	0.000
AR(2) test			0.124	0.170	0.168
Sargan test			0.052	0.059	0.048
Hansen J test			0.134	0.218	0.174
Difference-in-Hansen				0.904	0.685
Number of instruments			25	28	27
R-sqr	0.650	0.251			
N_of_obs	527	527	463	527	527
* p<0.10, ** p<0.05, ***p<0.01					

Standard errors in parentheses; 3 stars indicate statistical significance at 1% level; 2 stars show significance at 5% level; 1 star declares statistical significance at 10% level. For AR (1), AR (2) and Hansen J test p values are reported. DGMM_P and SGMM_P treat IT dummy as predetermined. SGMM_EN treats IT dummy as endogenous. Windmeijer's (2005) standard errors are used for each D-GMM and S-GMM estimation. Period dummies are not reported.

Table 1.5 Robustness tests. Inflation equation.

Inflation equation

	TE	CTE	DGMM_P	SGMM_P	SGMM_EN
	b/se	b/se	b/se	b/se	b/se
IT (advanced)	-0.074	-0.314	-1.137	-0.162	0.328**
	(0.31)	(0.47)	(1.91)	(0.26)	(0.15)
IT (emerging)	-1.167	-4.432***	1.607	-1.305	-1.529
	(0.82)	(1.13)	(2.96)	(0.82)	(1.14)
IT (against pegs)	-0.329	-2.366***	-1.653	-0.332	0.036
	(0.48)	(0.68)	(2.16)	(0.41)	(0.46)

Table 1.6 Robustness tests. Inflation volatility equation.

Inflation volatility equation

	TE	CTE	DGMM_P	SGMM_P	SGMM_EN
	b/se	b/se	b/se	b/se	b/se
IT (advanced)	0.138	-0.287	0.846	0.191	0.061
	(0.15)	(0.20)	(0.67)	(0.16)	(0.18)
IT (emerging)	-0.655	-1.501**	-3.312	-0.747**	-0.536
	(0.48)	(0.62)	(5.42)	(0.32)	(0.36)
IT (against pegs)	-0.122	-1.133***	0.212	0.009	-0.003
	(0.21)	(0.28)	(1.20)	(0.15)	(0.17)

Table 1.7 Robustness tests. Growth equation.

Growth equation

	TE	CTE	DGMM_P	SGMM_P	SGMM_EN
	b/se	b/se	b/se	b/se	b/se
IT (advanced)	0.499*	0.57	-1.573	0.532**	0.721**
	(0.29)	(0.40)	(2.11)	(0.21)	(0.29)
IT (emerging)	-1.028***	-0.184	-3.504	-0.335	-0.522
	(0.39)	(0.79)	(2.17)	(0.51)	(0.69)
IT (against pegs)	0.055	0.568	-1.804	0.612	1.038**
	(0.26)	(0.43)	(1.47)	(0.37)	(0.50)

Table 1.8 Robustness tests. Growth volatility equation.

Growth volatility equation

	TE	CTE	DGMM_P	SGMM_P	SGMM_EN
	b/se	b/se	b/se	b/se	b/se
IT (advanced)	-0.005	0.047	3.345	0.17	-0.074
	(0.18)	(0.26)	(3.65)	(0.30)	(0.31)
IT (emerging)	-0.647*	-0.094	1.377	-0.707	-0.529
	(0.38)	(0.54)	(1.70)	(0.42)	(0.39)
IT (against pegs)	-0.223	-0.113	0.067	-0.07	-0.201
	(0.20)	(0.27)	(1.08)	(0.26)	(0.25)

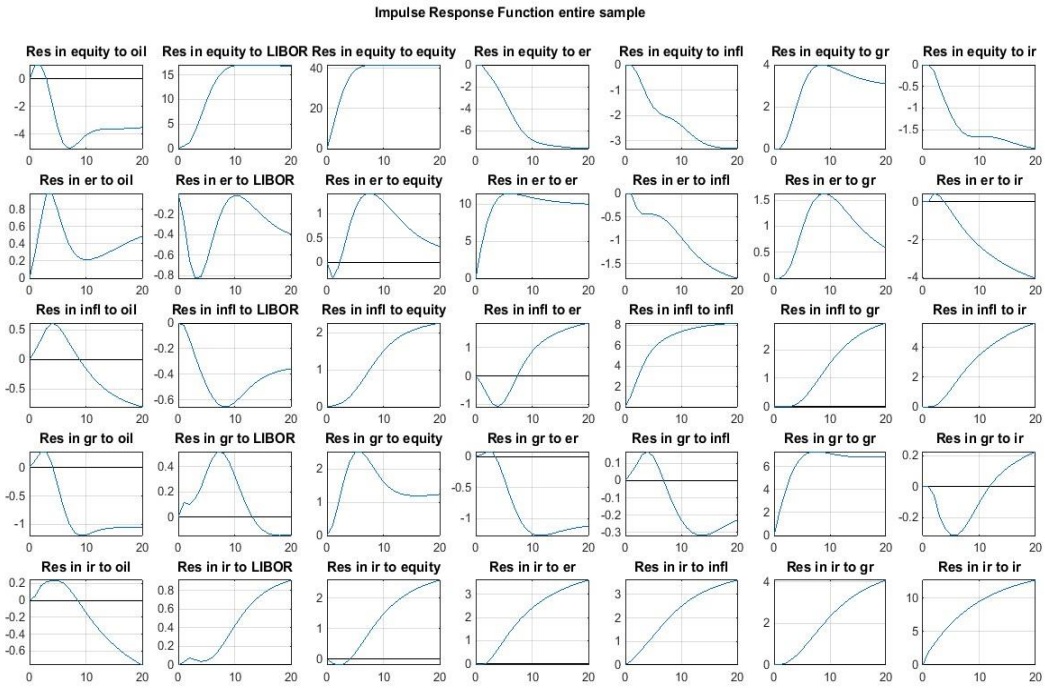


Figure 1.1 Impulse responses for the entire sample of countries.

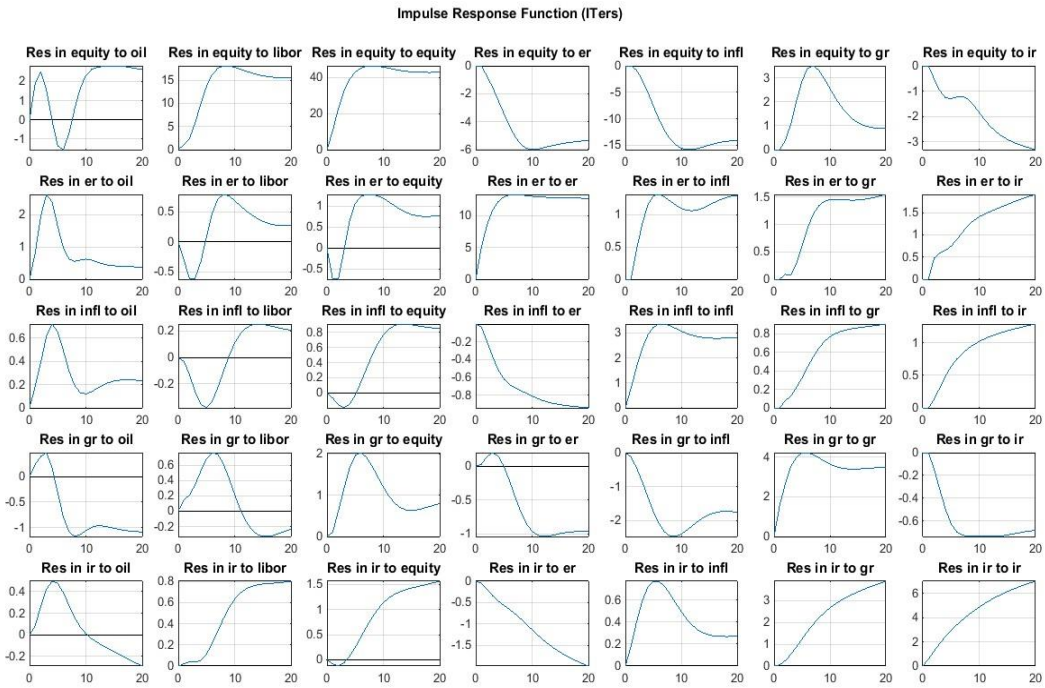


Figure 1.2 Impulse responses of Inflation Targeting countries.

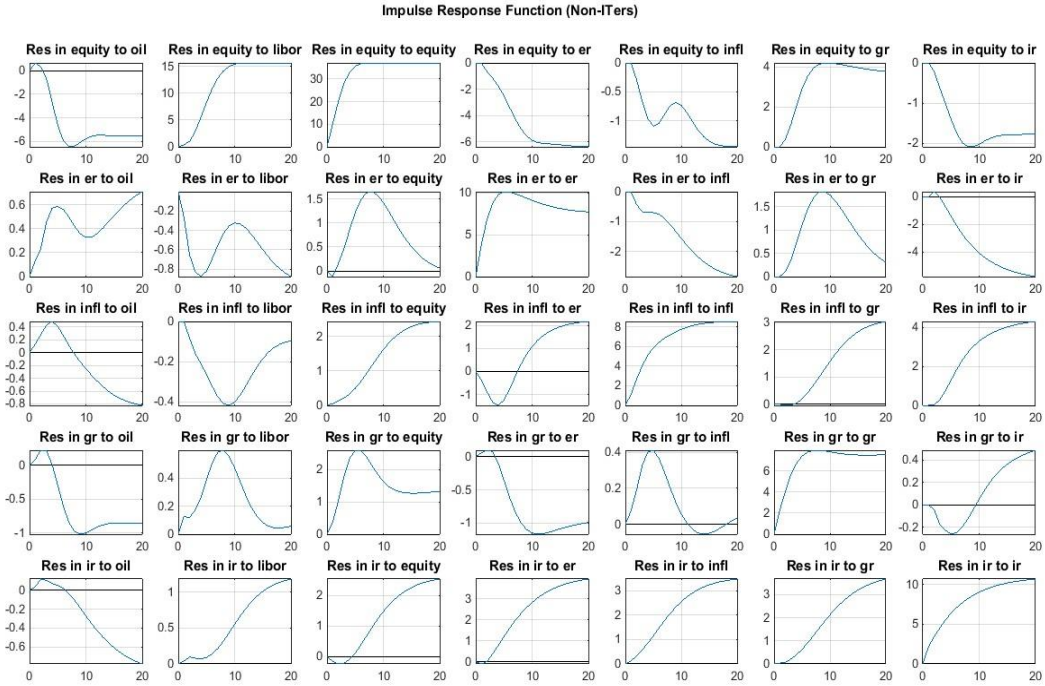


Figure 1.3 Impulse responses of non-Inflation Targeting countries.

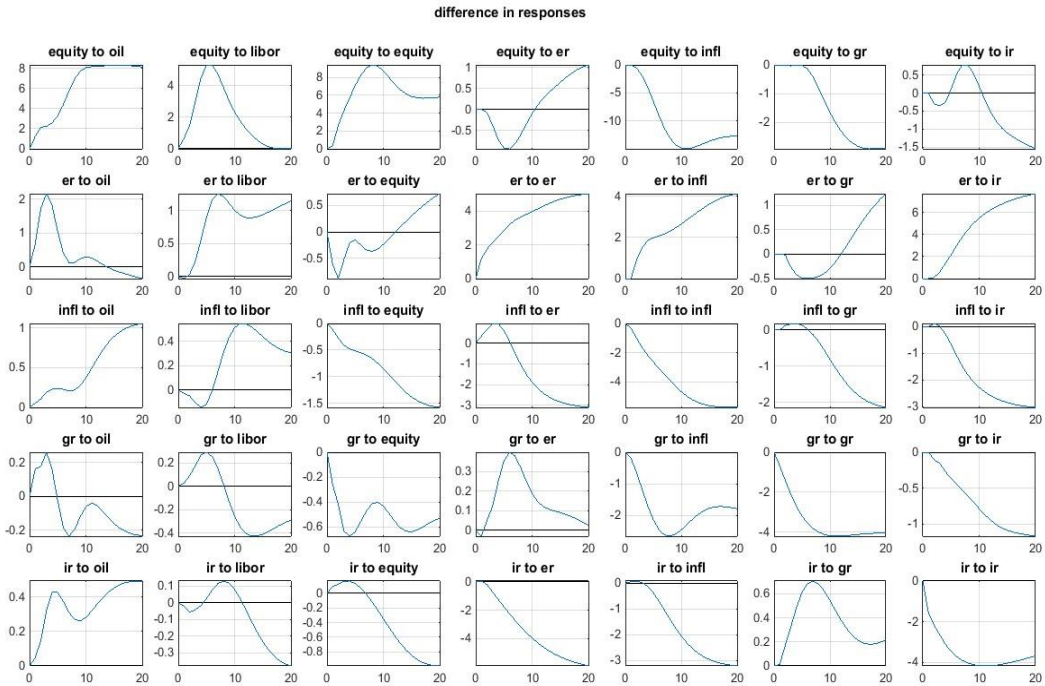


Figure 1.4 Difference between Impulse responses of Inflation-Targeting and non-Inflation Targeting countries.

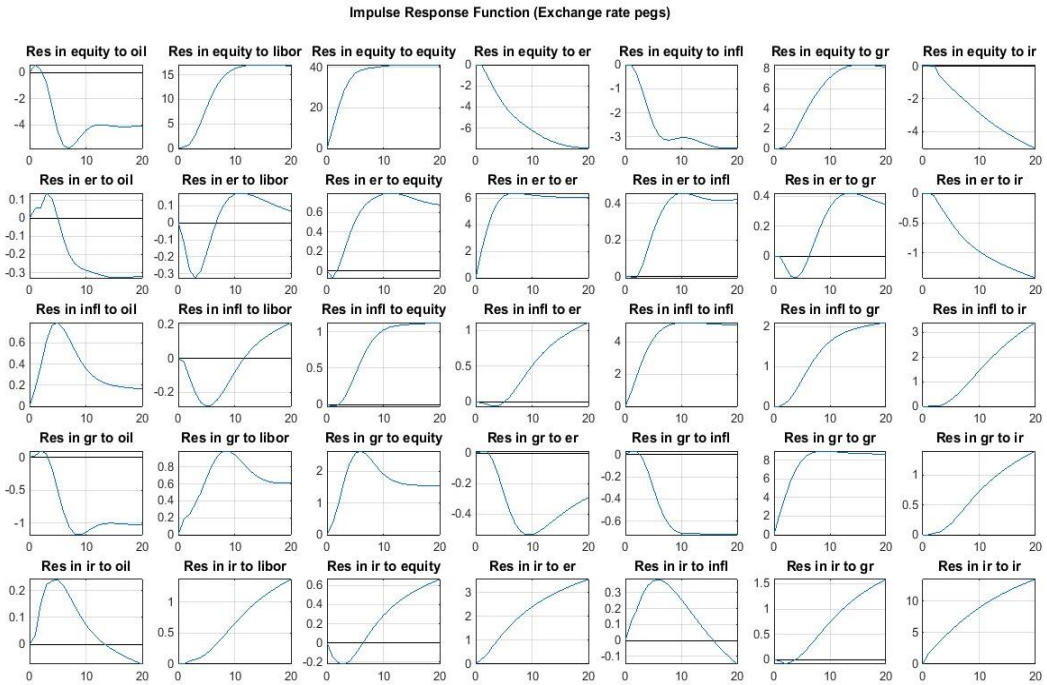


Figure 1.5 Impulse responses of Exchange rate pegs**.**

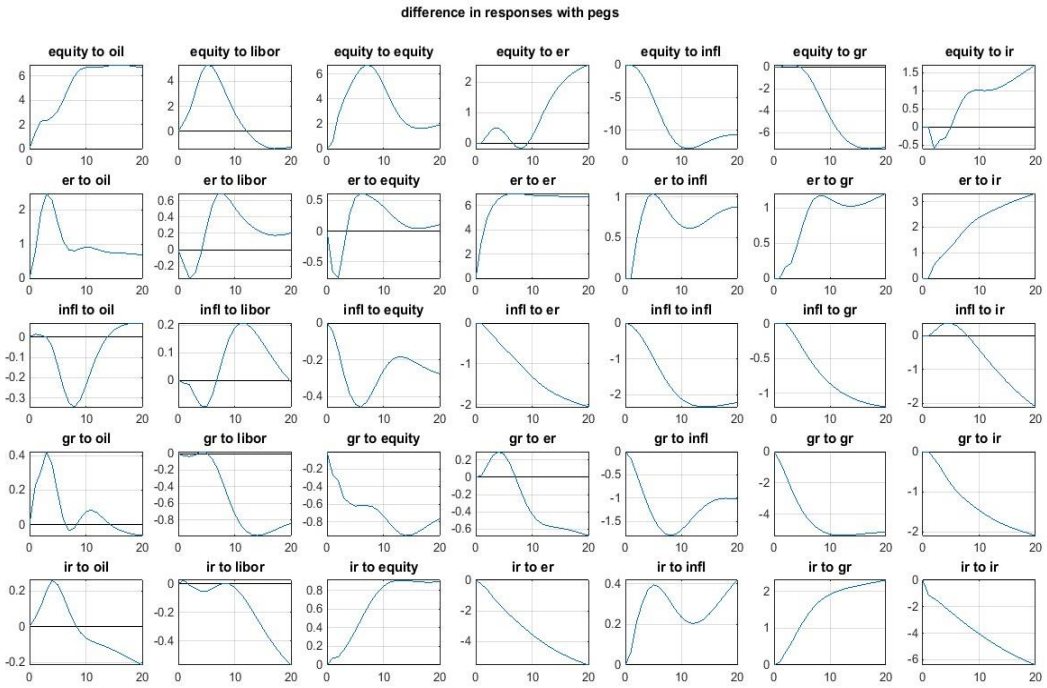


Figure 1.6 Difference between Impulse responses of Inflation-Targeters and Exchange rate pegs.

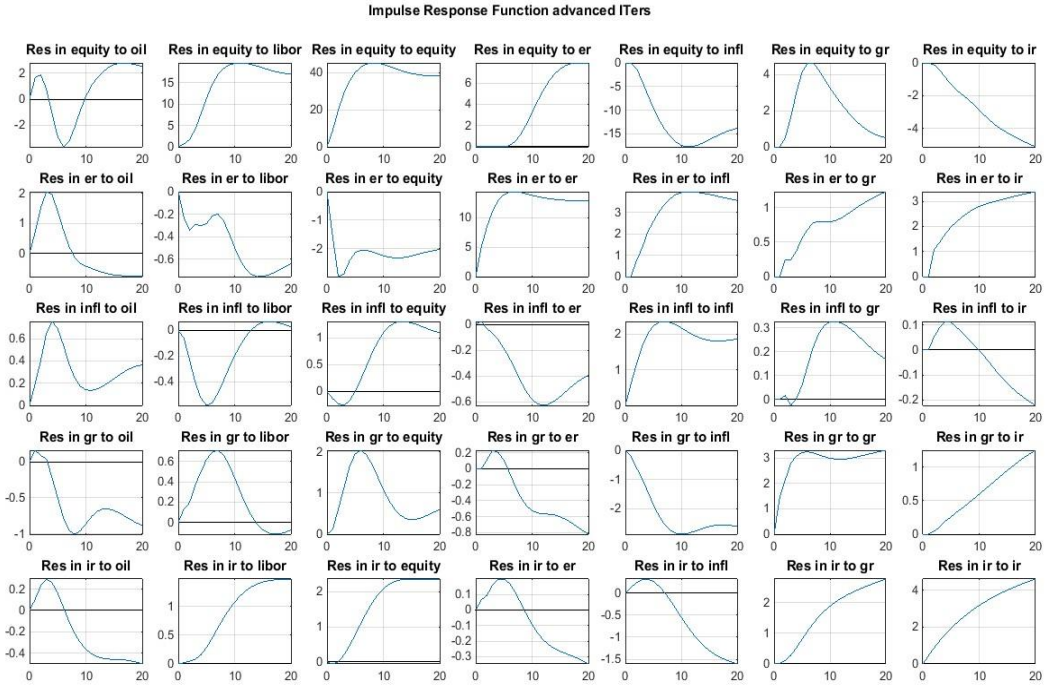


Figure 1.7 Impulse responses of advanced Inflation-targeting countries.

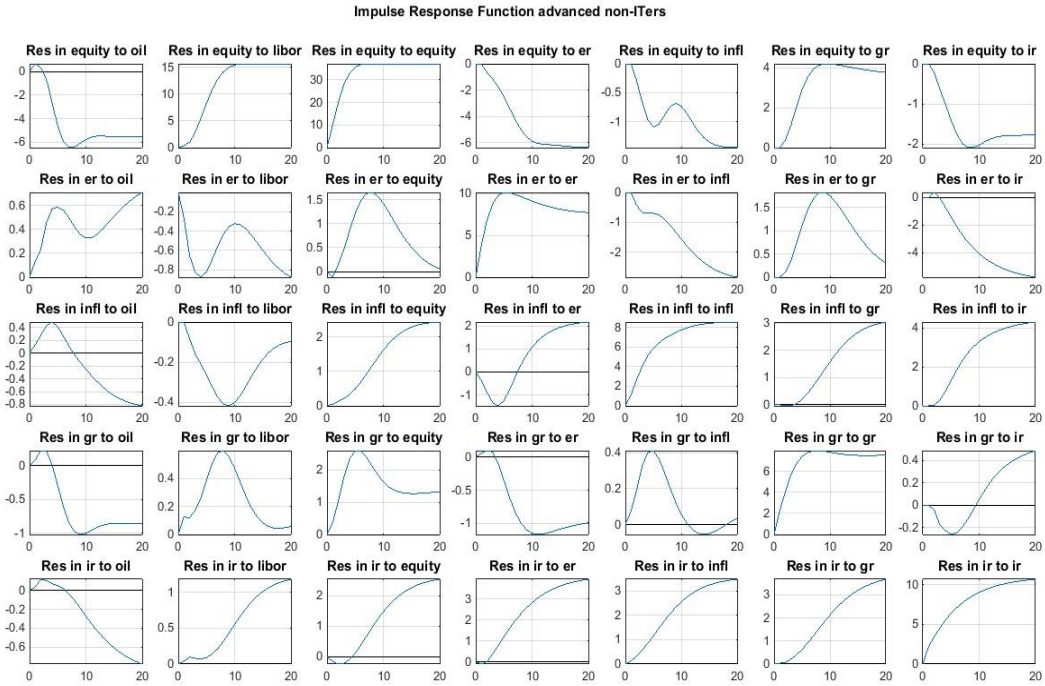


Figure 1.8 Impulse responses of advanced non-Inflation-targeting countries.

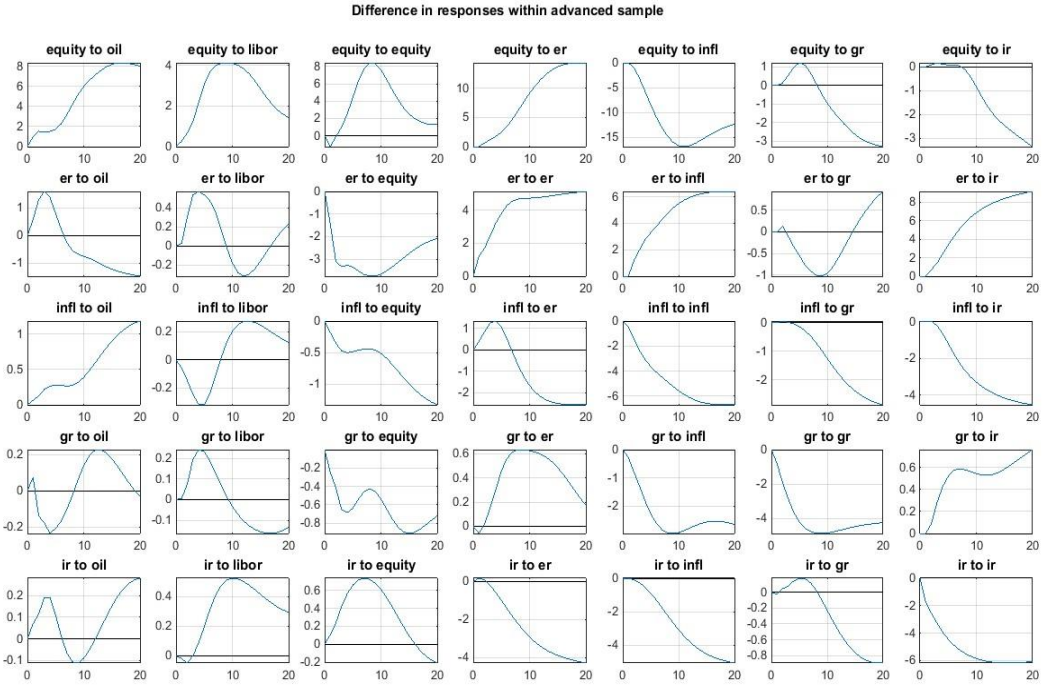


Figure 1.9 Difference between Impulse responses of Inflation-Targeting and Non-Inflation-Targeting countries within advanced sample.

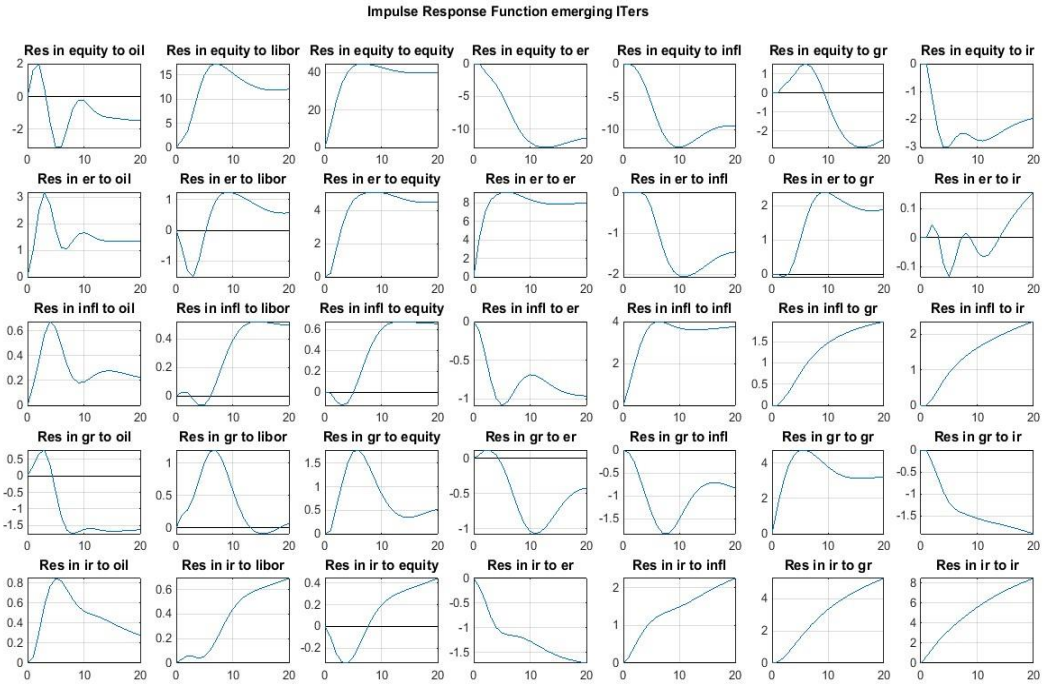


Figure 1.10 Impulse responses of emerging Inflation-targeting countries.

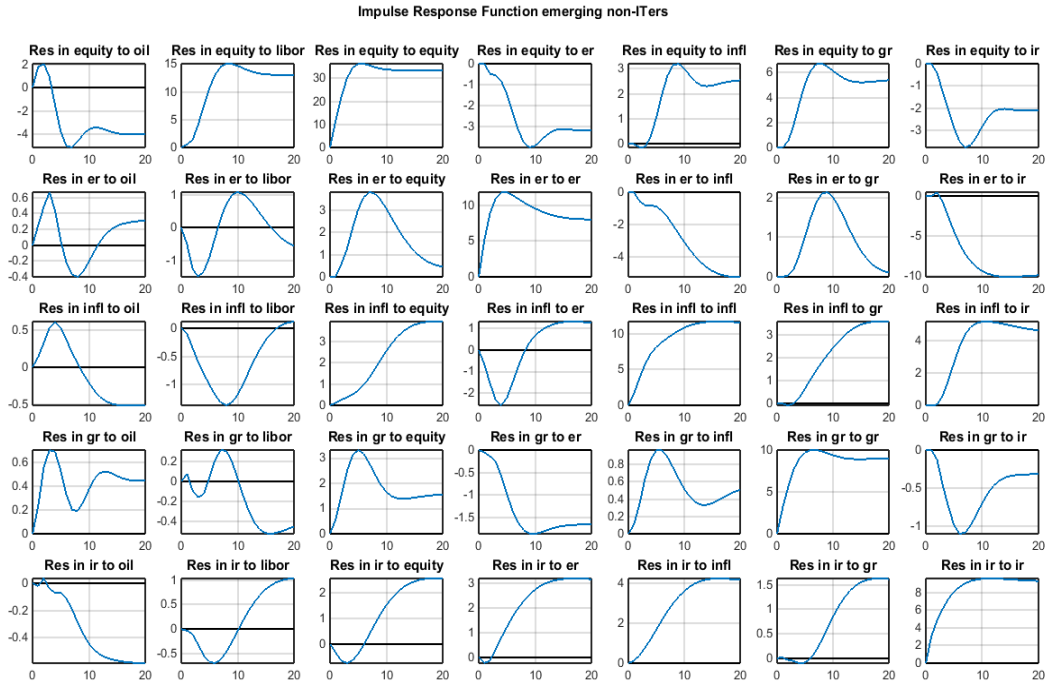


Figure 1.11 Impulse responses of emerging non-Inflation-targeting countries

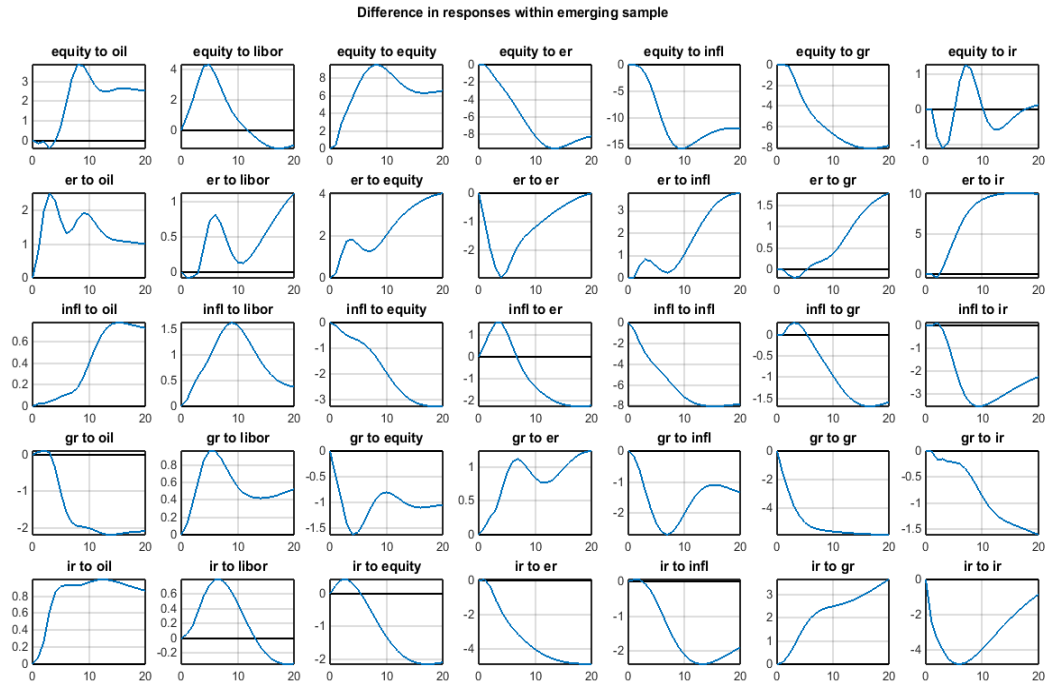


Figure 1.12 Difference between Impulse responses of Inflation-Targeting and Non-Inflation-Targeting countries within advanced sample.

CHAPTER 2: Determinants of the post-crisis recovery: Bayesian analysis

1. Introduction and literature review

Following the financial crisis in 2008-2009, most economies (especially the developed ones) recovered surprisingly slowly, compared to their recovery from previous economic downturns. For example, most peripheral European economies are still exhibiting growth rates that are just barely above zero (see Table 1). However, certain other countries, such as Germany and the United States, experienced renewed growth relatively quickly after the Great Recession that followed the crisis.

Are these differences purely arbitrary, or are there some macroeconomic fundamentals that may explain them? Were quicker recoveries a consequence of good policy decisions, or were they a result of institutional or monetary frameworks used before or during the crisis?

Some of the existing studies have investigated the determinants of recovery from some of the past crises. Before turning to the literature analysing the exposure to the Great Recession, I summarize some of those studies.

Park and Lee (2003) analysed the recovery after the 1997 currency crisis in East Asian countries using seemingly unrelated regression (SUR). Faster recovery speed from the currency crisis positively correlates with a substantial real depreciation, expansionary monetary and fiscal policy and improvement in the global economic environment. They also find out that the East Asian currency crisis was not much different from 176 currency crisis episodes from 1970 to 1995. A comparatively fast V-shaped recovery was due to the nature of the crisis as it was a liquidity crisis caused by investors' panic.

Hong and Tornell (2005) analysed the stylised facts and the determinants of the recoveries from a currency crisis using a dataset of over 100 developing countries over the period from 1980 to 1999. First, they find that the extent of investment/lending boom in the pre-crisis period and reserve inadequacy are important in determining the pace of post-crisis growth. Second, the extent of domestic credit growth as well as the ratio of the short-term debt to liquid assets appear as robust recovery determinants.

Aizenmann and Pasricha (2012) analysed the determinants of the tentative recovery based on capital and portfolio inflow measures using the data over 3 quarters: 2009Q2, 2009Q3, and 2009Q4. Among their findings is that the countries with greater external vulnerabilities, e.g. balance sheet exposure or increased leverage, saw a slower recovery of inflows. Countries with better banking supervision saw the faster recovery of portfolio inflows. Somewhat surprisingly, they also discovered that higher international reserves/GDP ratio is negatively correlated with the recovery of capital inflows.

Jovanovic (2012) investigated the determinants of recovery in emerging economies using the Bayesian Model Averaging approach on a sample of 47 economic crises that happened in 22 economies since 1980. The main result of this study is that the post-crisis growth depends positively on the expansionary monetary and fiscal policies, macroprudential regulation and

supervision and the currency crisis dummy (a currency crisis leads to a steeper fall in GDP which then leads to a larger recovery).

The economic consequences of the recent financial crisis are often compared to the Great Depression. At the same time, many researchers pointed out that some countries suffered much more than others. The determinants of the exposure to the financial crisis were investigated in a number of preceding studies and, here, I summarise some of their results.

Rose and Spiegel (2011) analysed the Great Recession using a large dataset of 107 countries, analysed a range of potential early warning indicators based on a Multiple Indicator Multiple Cause (MIMIC) model and discovered that most of the variables included appeared as marginally significant at most. There is some evidence of the significance of short-term debt, the current account deficit and the preceding stock market boom. They concluded that identifying useful predictors of the exposure to the financial crisis is a daunting task. It is worth noting though that this result was obtained without controlling for the heterogeneity of their sample in terms of countries' level of development, size and economic infrastructure.

Olafsson and Petursson (2012) analysed a sample of 46 advanced and emerging countries and a range of crisis propagation channels. Their results give reasons to be much more optimistic on the predictive power of the initial conditions. They conclude that the countries with sound fundamentals and flexible economic frameworks were better able to weather the financial storm. First, they find an important role for the macro channel. In particular, the countries with higher inflation, poorer fiscal positions, larger current account deficits, more leveraged private sectors and higher output volatility tended to experience deeper or more protracted contractions in output and consumption. They also find an important role for the financial channel. In particular countries with larger banking systems and stronger global financial linkages have experienced deeper output and consumption contraction.

Cecchetti et al. (2011) tried to address the same question as Olafsson and Petursson (2012) using a similar sample and econometric specification based on cross-sectional OLS. Given the international nature of the financial crisis, they measured the relative performance of the countries by identifying the global business cycle using a simple factor model and using the residuals from the principal component analysis as a measure of idiosyncratic performance. In addition, Cecchetti et al. (2011) included the policy response in their specification. They concluded that good performance during the recession arises from a combination of good policy decisions or institutions and good luck. Generally, better performing countries featured low loan-to-deposit ratios, a current account surplus and low private credit to GDP ratios. However, these economies also featured lower levels of financial openness and less dependence on the short-term funding coming from the US.

Among other influential studies are Berkmen et al., 2009; Lane and Milesi-Feretti, 2010; Claessens et al. 2010; Frankel and Saravelos, 2010; Feldkircher, 2014. Summing up, despite the significant number of studies on the exposure to the Great Recession, no consensus has been reached. Some of the researchers found no significant predictive power for the initial pre-crisis conditions, while others appeared to be much more optimistic arguing that countries with sound fundamentals fared much better during the Great Recession. Such a

discrepancy is a consequence of different samples, various approaches to the measurement of policy response and/or the dependent variable and econometric methodology used.

Given what we know about the financial crisis, in this study we aim to identify which factors were important for the post-crisis economic recovery of the countries in our sample. We choose a set of explanatory variables given the main recovery propagation channels identified in the crisis literature and when taking into account the recoveries from the vast range of preceding crises. Crucially, when analysing the recovery, apart from national characteristics or preconditions, we also have to consider the nature of the policy response. Following the recent financial turmoil policy makers across the world faced a difficult challenge, having to implement a range of programmes to bring their economies back to growth. For our research purposes, the measurement of the policy response is far from trivial, which is why I dedicate an entire section to it.

The model is estimated using Bayesian Model Averaging and then sense checked using Stochastic Search Variable Selection. In economic problems where there are many potential explanatory variables, there is huge uncertainty about which model to use. For example, in this model, I identified at least 17 possible explanatory variables, which means that the number of models to consider is equal to a vast number, $2^{17} = 131072$. The flexibility of Bayesian Model Averaging implies that none of the variables is assumed to be present in the model a-priori. Using our approach, we let the data decide which of the 17 auxiliary regressors could be useful for explaining the cross-country incidence of recovery. There is also another significant benefit of our approach. Since the econometric problem is considered in a finite sample, it could suffer from a problem of an insufficient number of degrees of freedom. According to Hotti and Sillanpaa (2006), in such cases, incorporating prior information could be useful to improve the efficiency of estimation. I give a more detailed overview of the methodology in the econometric model section.

Section 2 consists of several parts. It introduces the country sample and introduces the characteristics and the sources of the included variables. Then I discuss some stylized facts about the data pointing out its limitations and problems in estimation caused by them. Section 3 tackles a vital issue of estimating the degree of intervention by the authorities. Section 4 discusses the econometric model, pointing out its advantages and limitations. Then, I explain the empirical results and sensitivity analysis, drawing policy-relevant conclusions. Finally, Section 5 concludes.

2. The data description

2.1 The country sample

In this section, I describe the country sample analysed in this study. When choosing an appropriate country sample, the aim is to include countries of similar development level and with a reasonable level of data available on institutional and policy indicators. The data are collected for 20 OECD countries, which were the original OECD founders: Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg,

Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

From our sample, 19 countries are classified by Laurens et al. (2007) as developed economies. Turkey is the only emerging economy in the sample. Turkey's GDP per capita on a PPP basis is about 25 thousand dollars, which makes this country comparable in terms of development level to other countries in the sample. Finally, Luxembourg and Iceland can be classified as very small countries, i.e. those with a population below 2.5 million.

Our analysis includes 12 countries which are members of the Eurozone. Most of the countries in the sample have floating exchange rate regimes. Denmark pegs its currency, the Danish krone, to the euro within the ERM2 framework. Switzerland experienced significant currency appreciation after the financial crisis and reacted by pegging the Swiss franc to the euro. The effective peg remained in force from 2011 to 2015. 6 countries, in particular, Canada, Iceland, Norway, Switzerland, Turkey and the United Kingdom, follow a de-jure inflation targeting regime. All these countries can be classified as full-fledged stationary inflation targeters, although some countries, especially Turkey and Iceland, had significant periods when they missed their targets[2]. For a more granular classification of monetary framework, the reader is referred to David Cobham's database (www.monetaryframeworks.org).

During the recovery period the countries in our sample experienced very different growth rates. This paper examines the extent to which these differences could be explained by their national characteristics, pre-conditions in 2011 and policy responses.

2.2 Recovery indicators

In this subsection, I describe the approach that I take to measure the performance of the countries during the recovery, the dependent variable. Then I proceed to discuss the range of explanatory variables, the indicators which can potentially be used to predict a country's performance during the recovery. For precise definitions of the variables as well as data sources, the reader is referred to Table 7.

First, it is essential to understand that there is no single, optimal way to measure the extent to which countries recovered after the crisis. One of the common ways to address this is to contrast the actual performance against a counterfactual path based on the data observed up to the lowest point for GDP in the afternath of the financial crisis using either a structural Dynamic Stochastic General Equilibrium (DSGE) model, reduced-form Vector Autoregression (VAR) or some combination of the two. However, this approach may produce unrealistic scenarios for the recovery speed for countries that experienced heightened economic volatility in preceding years. For example, it may fail to capture instances where a country experienced an economic boom prior to the crisis along with economic performance levels that are no longer sustainable.

For robustness, I measure the performance of the countries during the recovery in two different model specifications. In the primary specification, the dependent variable is defined

[2] For example, according to Cobham's database, Turkey is classified as loosely structured discretion in 2008 and 2014. Iceland is classified as loosely structured discretion from 2008 to 2012.

as the growth rate of seasonally adjusted per capita GDP over the period from 2010Q1 to 2015Q4. A potential problem with this approach is that I model the cross-country incidence of the recovery as being due to the national characteristics. This is inappropriate if the fundamental causes of the recovery are international or are the result of a common shock. Therefore, I attempt to validate the conclusions of our study by using an alternative approach proposed by Cecchetti et al. (2011). Here, I define the dependent variable as the sum of the quarterly deviations from the principal component of the GDP per capita measure within a particular year during the recovery period from 2010 to 2015.

In this study, I introduce a slight modification to the methodologies that were used in the crisis literature (e.g. Olafsson and Petursson, 2010 or Cecchetti et al., 2011). I use measures based on GDP per capita to pick up on Reinhart and Rogoff's (2010) idea that with population growth the average person would still be worse off than before the crisis even if total GDP (or consumption) fully recovered.

The recovery speed was generally faster in those countries which contracted more during the global economic downturn. In this sense, the recovery might have been endogenous, because it could depend not only on the individual cross-country characteristics. As a remedy, the crisis performance is also included as an auxiliary variable in the regression equation. The crisis variable is defined as the change in the dependent variable from 2008Q1 to 2009Q4 according to IMF International Financial Statistics.

I use a range of potential explanatory variables to analyse which factors contributed to the recovery speed in individual countries. Since we are not sure about the correct econometric model, the number of potential macroeconomic variables is, of course, enormous. I use those that appeared in specifications of the recovery or Great Recession literature or might be reasonably thought to have been important in determining the economic performance.

The potential explanatory variables may be classified into several different categories. Potential recovery may depend on the financial development or banking sector indicators; monetary framework or exchange rate regime; institutional quality; openness to trade and foreign direct investment; government's debt and reserves; and policy response. These variables and their motivation are discussed in the following. A complete list of variable definitions and their data sources can be found in the Appendix.

The financial development and banking sector indicators

The first set of explanatory variables include three indicators of the financial and banking sector development.

Generally economists hold a wide range of different views on the importance of the financial system for economic growth. Overall, nowadays many believe that financial markets are not simply a by-product of the general development but really are an indispensable engine of a prosperous economy. According to Levine (1997), deep financial markets massively reduce transaction and debt monitoring costs, mobilize savings, enhance resource allocation, increase diversification and facilitate risk-management. Advanced financial markets also

provide an opportunity to hedge risks and allow cheaper and more accessible borrowing for the real sector.

A strikingly different view on the role of financial markets for the economic growth is expressed in a series of papers by Cecchetti and Kharroubi. In their earlier contribution, Cecchetti and Kharroubi (2012) documented that empirically the level of financial development is good for productivity only up to a point. Then comes a threshold, passed by advanced economies long ago, after which the financial development becomes detrimental to growth and potential output. The main interpretation of their finding is that the financial sector competes with the real sector for scarce resources and financial booms lead to a suboptimal resource allocation.

Cecchetti and Kharroubi (2015) developed a theoretical framework where they have shown that financial booms are detrimental to economic growth. In their model financial and non-financial companies compete for resources, most importantly, skilled labour. There are also two types of projects, one that offers higher expected return but lower pledgeability and the other low expected return but involves high collateral.

Skilled workers may work in both sectors. When employed by entrepreneurs, they help them succeed in R&D intensive projects which are difficult to pledge. When employed by financiers, they help in recovering default claims which allows financiers to cut the cost of funding.

Cecchetti and Kharroubi (2015) demonstrate that when the bargaining power of financiers is sufficiently large, then they are the ones who employ skilled workers. As a result, with abundant funding, entrepreneurs simply invest in low productivity and high collateral projects. Venture projects are not pursued which diminishes the extent of innovation and therefore in the long run is a drag on economic growth.

Indeed, many also believe that the financial crisis originated due to extreme financial sophistication which resulted in moral hazard and opaque financial operations. In a country with a large financial sector, where individual financial institutions become increasingly interdependent, shocks propagate very fast. Large financial markets and institutions may exacerbate the transmission of shocks to the domestic economy. Since the financial and particularly derivative market problems persisted for a long time after the crisis, this is one of the potentially important factors for the recovery.

The first variable considered is the financial deepening index constructed by Svirydzenka (2016). They construct a comprehensive financial development index capturing both financial institutions and markets. Within each of those, they measure their financial development. They define financial development as “a combination of depth (size and liquidity of markets), access (ability of individuals to access financial services), and efficiency (ability of institutions to provide financial services at low cost and with sustainable revenues, and the level of activity of capital markets).” They measure each of those components of financial development on a scale from 0 to 1 for both financial institutions and markets and then take a weighted average to come up with the financial development index estimate.

I include Bank capital to assets (%) from the World Bank's Global Financial Development Database (GFDD) into the empirical specification. This variable may be quite important because high banking leverage often indicates greater vulnerability to shocks and increases economic volatility (e.g., Claessens et al., 2010). For example, a limited amount of subprime mortgage defaults led to unprecedented economic losses because of securitization coupled with extreme banking leveraging. Later, during recovery, policy makers took a range of measures to decrease the leverage and increase capital adequacy requirements within Basel III agreements, which in turn may have impacted the flexibility to issue loans at least in the short term.

I also include the ratio of private credit to GDP from GFDD into the model specification. Given potentially different effects coming through, I include both a static component as measured by the ratio as of 2009 as well as first-differenced one-year lag of the variable. In theory, higher private credit spurs investment and consumption which in developed countries often becomes a critical growth contributor. Also, accessibility of credit is essential for re-establishing the economic recovery of the investment in the real sector. However, as Cecchetti and Kharroubi (2012) demonstrate the private credit to GDP ratio is associated with greater growth only up to a point, and then becomes a drag on both productivity and overall growth. Checking whether this finding holds as contrasted against a conventional view is particularly interesting given that our sample includes mostly financially advanced economies. Additionally, in countries where debt is already high, consumers might have less scope to borrow and increase their consumption during the recovery.

Monetary policy frameworks

Monetary policy over the recent decades has arguably become a key to weathering economic shocks. However, there has been much debate over the efficiency of various monetary frameworks, without any consensus reached.

The nature of the framework is potentially quite important because it determines the tools that a central bank may use to stimulate recovery after the crisis. Over the recent years, the inflation targeting (IT) monetary framework has gained much recognition for the positive effects it brings. For example, in our sample 6 of the member countries are using inflation targeting. According to Roger (2010), IT integrates most of the guiding principles for a monetary framework. Effectively, that means that a central bank understands the Tinbergen rule that they cannot efficiently pursue many independent objectives with only one instrument, the policy rate. They choose the target for inflation because high inflation harms growth and, therefore, leads to massive social welfare losses, while stabilising output at the natural rate is the best that can be done in the short term. IT is also usually associated with greater transparency in monetary policy conduct, which boosts the central bank's credibility. Moreover, some researchers found that IT helped to boost economic growth and reduce the level and volatility of inflation (see, e.g., Bernanke et al., 1999; Corbo, Landerretche, and Schmidt-Hebbel, 2002; Vega and Winkelried, 2005; Mishkin and Schmidt-Hebbel, 2007). Those findings have been subsequently challenged (see, e.g., Ball, 2010; Brito and Bystedt, 2010), but the debate on this is very much open.

One may argue though that inflation may not be the optimal variable to target during the recovery. On this, Svensson (2003) argued that inflation targeting is a framework rather than an instrumental rule. Therefore it allows the use of judgmental adjustment and the incorporation of external information. It makes inflation targeting more robust and easier to verify, taking the economy closer to the socially optimal equilibrium.

Another variable relating to monetary frameworks that we include in our specification is the Central Bank Autonomy score developed by Laurens et al., 2007. Their methodology of assessment of central bank autonomy is based on methodologies by Grilli, Masciandaro, and Tabelini (1991) and Cukierman (1992). Their so-called "full" score as in GMT depends on the political (i.e., the ability of the central bank to select the objectives of monetary policy) and economic (i.e., the ability of the central bank to select its instruments) dimensions of autonomy. However, it also includes Cukierman's elements, i.e., legislation of the central bank with regard to its chief executive officer; policy formulation by the central bank and its objectives; and the restrictions on central bank lending to the government. The CBA score may potentially be a relevant explanatory variable because some research pointed out that greater autonomy leads to better macroeconomic outcomes, such as lower inflation, improvement in financial system stability, and boost to fiscal discipline (see Arnone, Laurens, and Segalotto, 2006a for a survey of the literature). Whether those effects are significant particularly during the recovery, where the potential volatility is high and the coordinated response of the government and central bank may be crucial, is a research question.

Economic freedom and institutional quality

Economic freedom is defined as the fundamental right of every individual to control his or her own labour and property. Those rights inevitably have to be protected by strong institutions. Countries with higher economic freedom and institutional quality may be expected to weather shocks better as well as to recover faster from them. According to Acemoglu et al. (2004), the countries with better institutions deliver better long-run economic outcomes which imply that they may have higher resilience to economic shocks or volatility.

In recent years, many researchers represented the economic freedom and the institutional quality category by the Economic Freedom Index developed by Heritage Foundation (http://www.heritage.org/index/). The Index covers 12 quantitative and qualitative factors which can be related to four pillars of freedom. Those categories include the rule of law (property rights, government integrity, judicial effectiveness), government size (government spending, tax burden, fiscal health), the regulatory efficiency (business freedom, labour freedom, monetary freedom) and open markets (trade freedom, investment freedom, financial freedom).

I, however, include more specific variables measuring institutional quality rather an aggregated index into the empirical specification. This is largely because the correlation of the aggregated index and economic growth has not proven robust as demonstrated in several studies. As shown by De Haan and Siermann(1997), in most economic freedom indices some of the indicators appear as positively and significantly related to growth, while others may be

insignificant or even have negative relationship with growth. The arguments for the index as a determinant of growth are rather weak, while some of its components potentially may be related with a faster recovery.

To represent this category, I include Legal Structure and Security of Property Rights as a general institutional quality indicator, which may create positive investment climate during the recovery. It may also prove significant as many investors were often looking for a safe haven for their investments after the extreme volatility in the years of financial crisis.

Second, I include Credit Market Regulations as another institutional indicator which captures the level of regulatory prudence. This may have been important both for the resilience to crisis and faster recovery because it should prevent market participants from the excessive risk taking and moral hazard. This could also have manifested itself in a lower amount of troubled assets and derivatives which persisted for a long time after the crisis.

Both variables are sourced from Rose and Spiegel (2011) database as measured by the Economic Freedom of the World Annual Survey conducted by the Fraser Institute.

Openness to trade and foreign direct investment

The next set of explanatory variables relates to a country's openness to trade and foreign direct investment (FDI).

Some of the worst performing countries were those that had a substantial involvement in international trade, which left them exposed to macroeconomic instability through those linkages. In the aftermath of the crisis, larger trade openness might have actually boosted the performance as international trade started to recover. Trade openness is defined as the ratio of the sum of imports and exports to GDP.

We also include the current account balance as the percentage of GDP (World Economic Outlook, IMF) into our model specification. According to Claessens et al. (2009), the countries with large current account deficits may be more dependent on capital inflows. When the capital inflow is insufficient, these countries may experience exchange rate or banking crises, which in turn impact the speed of recovery. Also, one may argue that a country with a negative trade deficit would not be able to fully reap the benefits of the international trade recovery. Although theoretically trade is benefiting all the involved parties, there is a protectionist argument that imports help production in other economies rather than domestic.

We also attempt to measure the extent to which the country favours capital inflows using the FDI regulatory restrictiveness index, calculated by the OECD. The FDI index focuses on four measures: equity restrictions, screening and approval requirements, restrictions on foreign key personnel and other operational restrictions (such as limits on the purchase of land or on repatriation of profits and capital). During the crisis the reversal of FDI might have increased the vulnerability of an economy. During the recovery, however, openness to FDI may contribute to renewed growth. To be fair, FDI may be not the most volatile source of investment where investors usually engage in FDI with long-term investment horizons.

However, the data availability issues do not allow us to use such measures as foreign bank loans or remittance flows.

Government's debt and reserves

Many associate slow recoveries in some of the Eurozone countries with high debt burdens. Indeed, the Greek debt crisis is seen by many as a significant drag for growth across the European Union. The argument is that if a country's debt sustainability is in question, investors demand higher risk premiums for purchasing government debt issues. This, in turn, raises the debt interest payable by the government and therefore encourages the use of austerity measures, which reduce domestic demand and may reduce the speed of recovery.

The relationship between debt and economic growth has also been examined in the economic literature. In their seminal study, Reinhart and Rogoff (2010) concluded that while the overall link between the debt level and growth is relatively weak, countries that have debt levels above 90 percent, experience significantly lower growth rates. The median country grows about 1 percentage point slower than otherwise, while the average (mean) growth rates are several percentage points lower. They argued that this finding applies equally to advanced and emerging economies.

Their findings were subsequently challenged in several studies. For example, Herndon, Ash, and Pollin (2013) argued that the threshold vanishes after correcting for the coding error and selective exclusion of available data. Now upon crossing 90 percent threshold, the average growth turns from slightly negative to about 2 percent, which is about 1 percentage point lower than the average growth for lower debt levels. In their reply to Herndon et al (2013), Reinhart and Rogoff (2013) essentially accept the coding error but insist that their findings are not much different from their own. Despite the fact that the transition to lower growth levels is much more gradual, higher debt is associated with growth deterioration. They also point out that even 1 percentage point differential over the long horizon is a significant burden on economic outcomes.

In another contribution on the relationship between debt and economic growth Pescatori et al. (2013) address several issues of Reinhart and Rogoff's (2010) econometric approach. First, they consider a much wider range of thresholds rather than just 90 percent. Second, they consider long-term growth windows from the crossing of the threshold value, alleviating the problem of reverse causality where slow growth may contribute to the debt accumulation. Third, while R&R (2010) considered only the episodes where the debt remains above a certain threshold, Guajardo et al. (2014) basically condition on crossing the threshold, avoiding the selection of failures. Their results over shorter-term horizons are broadly consistent with R&R (2010), but for longer horizons Guajardo et al. (2014) find no threshold effects.

Despite this, the debate is very much open. Among studies that support the existence of a threshold beyond which economic growth is compromised are Cecchetti et al., 2011 and Baum, Checherita and Rother, 2013.

We also include international reserves as a percentage of GDP (WB GFDD) into the empirical specification. Insufficient international reserves to mitigate the effects of increased economic volatility are quite often associated with currency and banking crises. In theory, as the economy is restoring the growth, substantial international reserves should prevent the economy from going into a double dip recession in case of unexpected shocks. At the same time, Aizenmann and Pasricha (2012) analysed the determinants of the tentative recovery based on capital and portfolio inflow measures using the data over 3 quarters: 2009Q2, 2009Q3, and 2009Q4. Somewhat surprisingly, they also discovered that a higher international reserves/GDP ratio is negatively correlated with the recovery of capital inflows.

Policy response

One of the crucial elements to consider when thinking about the recovery after the recent financial crisis is the policy response. Monetary and fiscal authorities faced a difficult challenge, making use of both traditional and unconventional policy instruments.

It is well known that central banks drastically lowered their policy rate as a response to the financial crisis to the point where the policy rate came very close to the effective zero lower bound[3]. Central banks in the US, UK, and Eurozone used unconventional measures, such as large-scale asset purchases, to stimulate the economic recovery. In this environment, various researchers used shadow short rate (SSR) models to characterize the term structure of interest rates (Kim and Singleton, 2012; Bauer and Rudebusch, 2013) or quantify the stance of monetary policy (Wu and Xia, 2015; Bullard, 2012; Krippner, 2013). I also measure the monetary policy response as the `shadow` policy rate change (One year differences in 'shadow' policy rate between 2015Q1 and 2008Q1, IMF International Financial Statistics and Leo Krippner's shadow short rate database (https://www.rbnz.govt.nz/research-and-publications/research-programme/research-staff-profiles/leo-krippner)).

Generally, rate cuts should boost consumption and investment since they reduce the incentive to save. Rate reductions also allow the real sector to borrow at a cheaper cost. Whether this actually happens is a big question and depends on how leveraged the economy is.

Measuring the size of the fiscal response is also challenging, mainly because we are interested to see the underlying intentions of the government when implementing budgets. Official balances obviously do not show us this picture due to strong cyclicality of both revenue and expenditure statistics. Alberto Alesina in a number of his studies analysed fiscal adjustment episodes using cyclically-adjusted primary balances (CAPBs) on a sample of almost all OECD countries. Alesina and Perotti (1995) argued that some of those episodes were actually expansionary in the short run after their implementation. Such a view became known in the literature as the 'expansionary austerity' hypothesis.

For the purposes of our research, however, the use of CAPBs is suboptimal for reasons discussed in the following section.

[3] The recent course of economic history demonstrated that rates in reality may go slightly negative or slightly positive, but the existence of the bound is justified by a limit to arbitrage.

I make use of two approaches to adjust CAPBs and report two sets of results. In the first specification, I use asset price adjustment as suggested by Morris and Schuknecht (2011). In the second specification, I take advantage of the index produced using my own action-based dataset of fiscal actions in chapter 3.

Since the measurement of the policy response during the recovery is far from trivial, I dedicate the following section to this issue.

3. Measuring policy response

3.1 Monetary policy

3.1.2 Background on monetary response measurement

As a response to the crisis, most of the OECD countries drastically lowered their policy rates. Central banks faced with the effective-lower-bound for their nominal policy rates had to consider other options to bring the economies back to growth. Some central banks responded using so-called unconventional monetary measures (e.g. large-scale asset purchasing programmes (LSAP) as in the US and the UK). In general, a central bank implements LSAP by buying financial assets from non-bank financial institutions, thus raising their prices and lowering their yields which results in a boost to the money supply and domestic expenditure.

During the recovery period, the scale of such operations has been unprecedented, e.g., by 29 October 2014 when the Fed halted its purchases, they had accumulated about $4.5 trillion in assets, which was about a fivefold increase of their balance sheet. In the United Kingdom, the size of operations has been smaller but also very significant, with the total value of assets purchased amounting to £375 billion (see, for example, Joyce et al., 2012 and Rogers et al., 2014).

Assessing the impact of these measures or describing the overall stance of monetary policy in the unprecedented environment has proven to be quite a challenge. Previous studies of the US LSAP programmes include Gagnon et al., 2011; Hamilton and Wu, 2012; Swansson and Williams, 2012; Bauer and Rudebusch, 2013; D'Amico and King, 2013; Wu and Xia, 2016, Greenlaw et al. (2018) etc. Among the most influential studies of the UK quantitative easing programmes are Meier, 2009; Joyce et al., 2011; Breedon et al., 2012; Kapetanios et al., 2012; Goodhart and Ashworth, 2012; and Martin and Milas, 2012.

To assess the impact of QE on the economy, it is essential to contrast the actual economic recovery with an appropriate counterfactual. According to Joyce et al. (2012), conventional New Keynesian models cannot be used since at the ELB, money and bonds become perfect substitutes so that any swap has no impact on private sector wealth. Therefore, QE is a form of commitment and can have only a signalling impact. However, in theory, it has been shown that QE can work through the preferred habitat and duration channels. For example, Andrés et al. (2004) and Harrison (2014) built a DSGE (dynamic stochastic general equilibrium) model based on the microfoundations for preferred-habitat and portfolio-balance effects which is supportive of the role of unconventional measures in monetary policy. It is, therefore, plausible that the demand for assets is downward sloping, meaning that the supply of assets affects its relative prices and interest rates. However, according to Kapetanios (2012), in order to fully explain the macroeconomic effects of QE, the model must capture the frictions that generate the interest rate spreads and the linkages between the spreads and

the real economy. Christiano (2011) provides an overview of the related issues in this literature.

The present study makes use of Leo Krippner's database from the website 'Measures of the stance of United States monetary policy' (https://www.rbnz.govt.nz/research-and-publications/research-programme/research-staff-profiles/leo-krippner). Here I describe the methodology that was used for the construction of a so-called `shadow' short rate." SSR is the shortest maturity rate from the estimated 'shadow' yield curve. Intuitively, the unconventional policy actions such as in the recovery after the Great Recession are going to be reflected in SSR. Intuitively, the 'shadow' policy rate change reflects the reduction in the policy rates equivalent to the central bank's stimulus in a form of QE. It can freely move to negative values to reflect that the policy stance is more accommodative than a near-zero policy stance.

Generally, as discussed by Krippner (2016), there are two issues relating to the SSR, particularly for quantitative empirical applications. First, this is not the rate at which the agents can transact, since the nominal interest rate still remains ELB constrained. Second, the magnitude of SSR within unconventional periods may vary substantially due to model specification and the data used in estimation. For these two reasons, Bauer and Rudebusch (2016) and Christensen and Rudebusch (2015) recommend not using SSR estimates as a monetary policy indicator. Krippner (2015a) shows that three-factor SSR estimates do not correlate well with unconventional monetary policy events and sometimes produce counterintuitive values. He constructs a two-factor interest arbitrage free Nelson-Siegel model, the dynamics of which is driven by a Vasicek process, which is a continuous time analogue of an AR model.

3.1.2 Modelling approach

I choose to use Kripner's arbitrage-free Nelson and Siegel (1987) model, or K-ANSM, as the measure of monetary policy during the recovery since it at least gives an unbiased view on the actions of policy makers and produces the dynamics consistent with the monetary policy events in times of unconventional monetary policy (Krippner 2015a). This framework uses a continuous time Gaussian term structure model (GATSM) to represent the term structure, and the lower bound constrained policy follows:

$$\underline{r}_t = \max\{r_L, r_t\} \tag{3.1}$$

Where $\underline{r}_t$ is the lower-bound constrained short rate, a proxy to the observed policy rate, r_t is the shadow short rate and $\max\{r_L, r_t\}$ imposes the lower bound.

Krippner's estimates of the short rate use the arbitrage-free Nelson and Siegel (1987) model with two state variables, or K-ANSM(2) model to represent the shadow yield curve.

The shadow short rate depends on two latent state variables: the Level, L_t, and the Slope S_t:

$$r_t = L_t + S_t \tag{3.2}$$

The evolution of the state variables follows the Vasicek (Ornstein-Uhlenbeck) model:

$$dx_t = \kappa[\theta - x_t]dt + \sigma dW_t \tag{3.3}$$

Where

$$x_t = \begin{bmatrix} L_t \\ S_T \end{bmatrix}; \quad \kappa = \begin{bmatrix} \kappa_{11} & \kappa_{12} \\ \kappa_{21} & \kappa_{22} \end{bmatrix}; \quad \theta = \begin{bmatrix} \theta_1 \\ \theta_2 \end{bmatrix}$$

$$\sigma = \begin{bmatrix} \sigma & 0 \\ \rho\sigma & \sigma\sqrt{1-\rho_{12}^2} \end{bmatrix}$$

And dW_t is the 2 x 1 vector of independent Brownian motion (Wiener) terms.

Given that Vasicek model has an analytical solution, Krippner sets out the following Nelson-Siegel expression for the shadow forward rates:

$$f(t,u) = L_t + S_t e^{-\phi u} - \sigma_1^2 \cdot \frac{1}{2}u^2 - \sigma_2^2 \cdot \frac{1}{2}\left[G(\phi,u)\right]^2 - \rho_{12}\sigma_1\sigma_2 \cdot uG(\phi,u) \tag{3.4}$$

Where $G(\phi,u) = \frac{1}{\phi}[1-e^{-\phi u}]$

K-ANSM(2) lower-bound constrained forward rates are specified as follows:

$$\underline{f}(t,u) = r_L + [f(t,u) - r_L] \cdot \Phi\left[\frac{f(t,u)-r_L}{\omega(u)}\right] + \omega(u) \cdot \phi\left[\frac{f(t,u)-r_L}{\omega(u)}\right] \tag{3.5}$$

Where $\Phi[\bullet]$ is the cumulative unit normal probability distribution function, $\phi[\bullet]$ is the unit normal probability density function:

$$\phi[\bullet] = \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}\left[\frac{f(t,u)-r_L}{\omega(u)}\right]^2\right)$$

And $\omega(u)$ is:

$$\omega(u) = \sqrt{\sigma_1^2 \cdot u + \sigma_2^2 \cdot G(2\phi,u) + 2\rho_{12}\sigma_1\sigma_2 G(\phi,u)}$$

The interest rates for the entire range of maturities (0.25, 0.5, 1, 2, 3, 5, 10 and 30 years) are derived using the standard term structure relationship:

$$\underline{R}(t,\tau) = \frac{1}{\tau}\int_o^\tau \underline{f}(t,u)du \tag{3.6}$$

The model is estimated using the iterated extended Kalman filter, which allows for the non-linearity of $\underline{R}(t,\tau)$ with respect to the state variables. In total, there are 10 parameters to estimate, that is, $B = \{\phi, \kappa_{11}, \kappa_{12}, \kappa_{21}, \kappa_{22}, \theta_1, \theta_2, \sigma_1, \sigma_2, \rho_{12}\}$. The lower-bound of the short rate is set to $r_L = 12.5$ basis points.

The transition equation for the latent factors follows VAR(1) form:

$$x_t = \theta + e^{-\kappa\Delta t}(x_{t-1} - \theta) + \varepsilon_t \tag{3.7}$$

Where $_{\Delta}t$ denotes the difference in time is steps between the observations (Krippner uses daily data) and ε_t is the vector of $N(0,1)$ innovations to the state variables.

The measurement equation for the K-ANSM(2) model is:

$$\begin{bmatrix} R_t(\tau_1) \\ \vdots \\ R_t(\tau_K) \end{bmatrix} = \begin{bmatrix} \underline{R}(x_t, \tau_1, B) \\ \vdots \\ \underline{R}(x_t, \tau_K, B) \end{bmatrix} + \begin{bmatrix} \eta_t(\tau_1) \\ \vdots \\ \eta_t(\tau_K) \end{bmatrix} \tag{3.8}$$

Where η_t denote the measurement error, that is unexplained by K-ANSM(2) model. The covariances between η_t and ε_t are assumed to be zero.

As a result of the filtering procedure, it is possible to derive the estimates of the latent factors and, hence, of the SSR. We use the estimates of the SSR for the United States and the United Kingdom since, during our estimated period of recovery, those were the only countries that implemented unconventional measures.

The European asset purchasing programme was initiated only in March 2015 in the dramatic change of policy after the announcement of Mario Draghi, President of European Central Bank. Sveriges Riksbank also launched its asset purchasing problem at the beginning of 2015. Our sample period is such that we omit those programmes from the analysis.

3.2 Fiscal policy

3.2.1 Background on fiscal response measurement

A consensus in the literature on the size of the fiscal multiplier in effective lower bound environment (represented by Christiano, Eichenbaum and Rebelo 2011; Woodford, 2011; Swanson and Williams, 2013) is that when the nominal interest rate is irresponsive to an increase in the government spending, the "crowding-out" of private investment does not occur, and the fiscal multiplier becomes much larger. This finding contributes to the Keynesian view on the fiscal multiplier.

However, over the recent years, some governments in advanced economies leaned towards austerity and fiscal consolidation. This, in a way, has been driven by the academic literature on the relationship between debt ratios and growth rates (discussed in the data description section) and, even more importantly, on expansionary fiscal contractions (EFSc).

Giavazzi and Pagano (1990) contrasted the traditional view on fiscal contraction with another contending view, which they referred to as the "German view", - that stresses the role of the current changes in taxes and government spending as signals of future intended changes. "German view" theoretically may be justified with the appeal to "Ricardian equivalence", where consumers expect that tax rises will be followed in due course by tax cuts. Based on two examples of Denmark and Ireland, the authors concluded that expansionary consolidation may find some empirical support. In particular, consolidations in Denmark and Ireland generally resulted in dramatic reduction of the interest rates, which, in turn, reduced borrowing costs and boosted consumer confidence. Those effects outweighed the immediate reduction of aggregate demand.

The EFC hypothesis has subsequently been taken forward mainly by the work of Alberto Alesina in a series of studies (e.g. Alesina and Perotti, 1995; Alesina and Ardagna, 1998, 2010, 2013). Initially, the focus was on the idea that expenditure-cut-based fiscal consolidations result in better economic outcomes than tax-rise-based ones. At a later stage, their results are centered around the idea that fiscal consolidations are not always followed by the output contraction. Alesina and Ardagna (2010) conclude that fiscal adjustments on the spending side are almost as likely to be associated with high growth as fiscal expansions. Moreover, they emphasise that due to long-lasting benefits of deficit reductions, fiscally prudent governments were often more successful during elections than fiscally loose ones.

According to Islam and Chowdhury (2012), Alesina's work influenced a number of pro-austerity politicians both in the EU and UK. A summary of the so-called Madrid paper, Alesina (2010), even became a part of the official communiqué of the EU finance ministers meeting of April 2010. At the same time, Islam and Chowdhury (2012) note that among 107 fiscal adjustments considered by Alesina and Ardagna (2009) only 26 cases were associated with output expansions.

Methodologically Alesina's analysis might be associated with measurement errors since their definition of fiscal adjustment relies on the OECD CAPB measure. Guajardo et al. (2014) showed that CAPBs remain strongly correlated with the cycle meaning that during expansions the deficits usually decline, while during recessions they often expand. As a result, Alesina and his co-authors used measures of structural balances which still remained correlated with the cyclical forces. It implies that endogenous effects conceal the true structural position of governments, effectively violating an implicit exogeneity assumption needed for an unbiased causal estimate. Estimating regressions using CAPBs is a priori more likely to produce favourable evidence for the episodes of fiscal adjustment.

Fatas and Mihov (2000) found that a one percent positive GDP deviation from the trend leads to an almost 0.8 percent increase in revenues but only raises expenditure by 0.03%. One of the main challenges may be that the conventional measures of CAPB do not take into account the fact that revenues respond not only to fluctuations of output but also to variability in asset prices. During upturns unexpected windfalls of revenues boost not only nominal balances but also the cyclically adjusted primary balances (CAPB) as usually calculated. The opposite also occurs during downturns.

A review paper by IMF (2010) has shown that an action-based approach used to identify fiscal consolidation produces strikingly different results. They use the findings also described in Pescatori et al. (2011) who followed Romer and Romer's (2010) historical approach (identifying 173 discretionary fiscal policy adjustments) and show that Alesina and Perotti's (1995) definition of fiscal adjustment does not account for the fluctuations in government revenues due to the cycle. The result suggests that 'painless' consolidation may be too good to be true. In particular, they find that fiscal consolidation of 1 percent of GDP typically reduces output by about 0.5% and increases unemployment by 0.3% over two years post implementation. For the explanation of how the IMF calculates structural balances refer to Fedelino, Ivanova, Jorton (2009).

According to Krugman's blog (https://www.theguardian.com/business/ng-interactive/2015/apr/29/the-austerity-delusion), even the IMF's analysis fell short as the institution eventually acknowledged. The reason is that most episodes of austerity were under

conditions very different than during the recovery after the recent financial crisis. Historically, monetary policy was often used to soften the recessionary effect from fiscal consolidation. Interest rates were much lower this time, so monetary softening appeared much more challenging. Additionally there are other factors omitted from their analysis, including exchange rate policy, global economic cycle or structural reforms, which inevitably influence growth.

Jordà and Taylor (2013) shed some more light on this debate. First, using OLS they replicate the expansionary austerity finding using a conventional definition of CAPB. They note, however, that even this result is driven by what happens in booms. In slumps, the regression coefficients are not statistically different from zero and in many cases negative. Second, given measurement difficulties, they turn to the narrative identification of the CAPB and use it as an instrumental variable for CAPB. They bring the results to a comparable replication framework and discover that austerity is unambiguously contractionary. Next, they turn to examine the validity of the narrative instrument. Given exact identification, formal testing is not available. However, they demonstrate that the narrative instrument may be predicted by some of the excluded controls, which are also correlated with the outcome. As a result, they reject the hypothesis that narrative dates are truly exogenous events. Therefore, they attempt to correct for the endogeneity using an augmented inverse propensity weighted (AIPW) estimator, reporting results which are much closer to the IV than to least squares.

3.2.2 Specification using Morris and Schuknecht (2007)'s asset price correction

In an attempt to capture some of the omitted effects, the present study uses the IMF dataset and follows Morris and Schuknecht (2007, hereinafter M&S)'s approach to alleviating the problem of measuring fiscal response. The idea is to estimate short- and (where relevant) long-term elasticities for four revenue categories (direct taxes on corporations, direct taxes on households, indirect taxes, and taxes on financial transactions) with respect to equity and residential property prices and then relate those elasticities to a cyclical component measure. This approximates how much of the movement in the structural balance is due to the business cycle fluctuations.

Data for the four tax categories are obtained from the OECD Revenue Statistics. Direct taxes on corporations are measured as Taxes on income, profits and capital gains of corporates (code 1200 in OECD Revenue Statistics); direct taxes on households as Taxes on income, profits and capital gains of individuals (1100); indirect taxes as Taxes on goods and services (5000); and taxes on financial transactions as Taxes on financial and capital transactions (4400).

Data for the relevant tax bases were obtained from the European Commission's AMECO database. For direct taxes on corporations, I use gross operating surplus; for direct taxes on households I use the compensation to employees; for the indirect taxes disposable income rather than private consumption is used in order not only to allow for the direct impact of asset prices on indirect taxes but also to capture indirect effects coming through changes in the propensity to consume.

In principle, the fiscally most relevant data series would be overall wealth held in property and equities. However, since the data are not available for a sufficiently long period, in line with Morris and Schuknecht (2007), the present study uses the data on asset prices instead.

Data for national asset price indexes are obtained from IMF IFS database and residential property price data from the Bank of International Settlements database.

Overall, the empirical analysis points to significant and positive asset price effects for all four revenue categories for most countries in the sample. The coefficient of residential property prices on direct and indirect taxes appeared to be negative and marginally significant which may be due to positive (capital gains) and negative (mortgage interest deductibility) effects offsetting each other. Asset price dynamics seem to be most relevant for transactions taxes and corporate taxes, while their influence on direct household taxes and indirect taxes is less significant.

From an accounting perspective, one can express these effects in an equation of government tax revenue as follows:

$$R = t_y Y + t_c c_y Y + t_w \Delta w + t_c c_w (1 - t_w) \Delta w + t_t \sigma_w \quad (3.9)$$

Now, tax revenue (R) consists not only of taxes on income ($t_y Y$) and taxes on consumption out of income ($t_c c_y Y$) as appears to be the case in the common measures. It also includes taxes on changes in wealth, i.e., capital gains ($t_w \Delta w$), taxes on consumption out of increased wealth ($t_c c_w (1 - t_w) \Delta w$) and taxes on the transfer of wealth ($t_t \sigma_w$), where σ refers to market turnover. The data on all the tax categories is taken from OECD Revenue Statistics and the European Commission's AMECO database.

The result of the M&S procedure is the derivation of the cyclical component of the budget balance related to asset prices:

$$CC_t^{AP} = \sum \left(\frac{T^i}{GDP} \right) * (t-1) * \varepsilon^{ij} * (AP_t^j - AP_t^{jTR}) \quad (3.10)$$

where T^i/GDP is the ratio-to-GDP of tax category i, ε^{ij} is the elasticity of tax category i to asset price j and $(AP^j - AP^{jTR})$ is the deviation of the asset price j from its Hodrick-Prescott trend value, which might be thought to indicate whether the asset prices are above or below the trend. Unfortunately, the Hodrick-Prescott filter measure of the trend is highly problematic and suffers from the end point problem, which implies a likely underestimation of the deviations from trend at the end of the sample period. In the paper ($\mathrm{CAPB} - \mathrm{CC}^{AP}$) is used as the variable for the government intervention or discretionary fiscal action. The unadjusted IMF structural balances are presented in table 5, while the results of the asset price adjustment are presented in the table 6.

Figure 5 illustrates broad results of the fiscal adjustment starting from 1999. In the early 2000s OECD economies experienced a period of widening structural deficits. From 2000 to 2004, IMF's measure of CAPB dropped from balanced to about -2.5%. It is worth mentioning that the effect of generally rising asset prices, made this trend seem less sharp. From 2005 to 2007, there is a trend for some structural fiscal consolidation across the sample.

During the global financial crisis, most countries used a discretionary fiscal expansion to combat the effects of the financial storm on the real economy. At the same time, the deficits published by IMF seem to be implausibly large. For example, in 2009 according to the IMF

procedure, the average deficit amounted to around 4.9% while according to the Morris and Schuknecht (2007) procedure the average deficit was about 4.3%. Over most of the recovery, from 2010 up to 2013 the increase in IMF's balance measures was faster than in adjusted ones. This was partly due to the rising asset prices. From 2014, though, as adjusted balances catch up, the recovery of balances becomes structural.

Overall, however, the difference in the path between the measure constructed using Morris and Schuknecht correction and original IMF series is not as large as could be expected a priori. Although Morris and Schuknecht's correction produces an adjustment in the expected direction, the structural balance estimates remain correlated with the economic cycle. Partly this is due to other factors concealing the underlying government intentions. The asset prices are only a proxy for wealth, so components of revenue such as the taxes on capital gains, taxes on consumption out of increased wealth and taxes on the transfer of wealth might be imprecisely measured. Apart from asset prices there are many other temporary factors influencing both expenditure and revenue statistics, such as commodity prices and other transitory shocks. Additionally, the calculations of fiscal balances depend on the potential output estimates, which sometimes are significantly amended a posteriori and suffer from the end point problem as discussed in relation to HP filtering to estimate cyclical component (a stark example of this is the effect of the financial crisis on trend output: presumably there has been some combination of a step fall in potential output and a change in the underlying growth rate of potential output, and it is not obvious how to disentangle these two effects).

3.2.3 Specification using own Action-Based dataset

Therefore, I also attempt to identify the structural government position using a completely different technique. In Chapter 3, I endeavour to identify the fiscal action using a historical approach similar to that of Ramey and Shapiro, 1998; Romer and Romer, 2010; Pescatori, Leigh, Guajardo and Devries, 2011; and Ramey, 2011. More specifically, I am constructing the fiscal action dataset by analysing policy documents such as European Commission Reports, Budget Statements and Speeches, IMF Article IV reports and OECD Economic Surveys and country-specific policy documents.

I construct a categorical variable describing a country's fiscal stance in a particular year, ranging from 3 (which means the tightest form of austerity) to -3 (which means the injection of a massive fiscal stimulus). The thresholds used to classify the fiscal stance are arbitrary in nature, but they plausibly discriminate between categories and should give us an objective view. A discretionary fiscal effort differing from a no-policy scenario by between -0.2 and +0.2% of GDP receives a 0 score; fiscal effort in either direction of a magnitude more than 0.2% of GDP, but less than 1% of GDP gets 1; more than 1% but less than 2% of GDP - score 2; and if more than 2% of GDP - score 3.

The resulting variable represents the fiscal stance of a government at a particular year. For, example if the government of a country decided to implement a discretionary stimulus package of a size equal to 1.5 % both in 2009 and 2010, then the fiscal score is -2 in both years.

The objective is to identify the intentions of an individual government at a time of submitting their budget. Apart from the abstraction from the economic cycle, the action-based dataset does not involve any calculations of potential or trend output, so it is immune to the issue of possible changes in trend as a result of the crisis, as discussed above.

In the empirical application, I make use and report the results of fiscal policy adjustments measured using both M&S's approach and my own constructed dataset.

4. Econometric Model

4.1 Bayesian Model Averaging

Our unrestricted empirical model is specified accordingly:

$$\begin{aligned}\text{Recovery}_{i,t} &= \beta_1 \text{Crisis}_{i,2008/9} + \beta_2 \text{FinDeep}_{i,t-1} + \beta_3 \text{BankCapAsset}_{2009} + \beta_4 \text{PrivCredit}_{i,2009} \\ &+ \beta_5 \Delta\text{PrivCredit}_{i,t-1} + \beta_6 \text{IT}_{i,2009} + \beta_7 \text{CBIndependence}_{i,2009} + \beta_8 \text{LegalStructure}_{i,2008} \\ &+ \beta_9 \text{CreditMarketRegulations}_{i,2008} + \beta_9 \text{TradeOpeness}_{i,2009} + \beta_{11} \text{FdiRestrictivenessIndex}_{i,2010} \\ &+ \beta_{12} \text{CurrentAccountBalance}_{2009} + \beta_{13} \text{Debt}_{i,2009} + \beta_{14} \text{IntReserves}_{i,2009} \\ &+ \beta_{15} \text{StructuralBalance}^*_{i,2009 \text{ or } (t-1)} + \beta_{16} \Delta\text{StructuralBalance}_{i,t-1} + \beta_{17} \Delta\text{PolicyRate}_{i,t-1} + \varepsilon_{i,t}\end{aligned} \quad (4.1)$$

In our specification the dynamic variables appear with a one-year lag while precondition variables are static and appear as measured in 2009 where the data is available. Amongst things to note, the measurement of $\text{Recovery}_{i,t}$ and $\text{Crisis}_{i,2008/9}$ varies depending on whether we use primary model specification or Cecchetti et. al. (2011)'s approach. Also, in the case of M&S asset price adjustment $\text{StructuralBalance}_{i,2009}$ variable is a precondition as of 2009, and in the case where I use my own classification the $\text{StructuralBalance}_{i,t-1}$ is a dynamic variable measured with one-year lag.

Our model is estimated using Bayesian Model Averaging (developed by Raftery, 1998). This approach is attractive because it addresses the uncertainty at two distinct levels. First, it is uncertainty about the estimate conditional on a given model. Second, when we examine the determinants of the recovery, we need to accept that the specification of the reduced form empirical model is a-priori unknown.

First, I describe the Bayesian Model Averaging methodology.

With m candidate regressors, there are 2^m possible models to evaluate. An arbitrary model M_j with the explanatory variables grouped in Z_j takes the following form:

$$y = Z_j \beta_j + c\varepsilon \quad (4.2)$$

Where y is an Nx1 dependent variable measuring recovery performance in N different countries; ε is an Nx1 innovation vector assumed to be normally distributed with mean zero and identity covariance matrix; $c \in \mathcal{R}_+$ is a scale parameter; all auxiliary regressors are included in Z and any combination of them can appear in Z_j; and all the relevant regression coefficients are grouped in $\beta_j \in R^{m_j}$ where $0 \le m_j \le m$.

One of the most challenging parts of the analysis is eliciting priors about model parameters. Since improper priors (with distributions that don't integrate to 1) often lead to proper posteriors, the use of improper priors is not always a problem as long as the analysis is based on a single model. However, when comparing different models (as we do within the BMA approach), improper priors on all of the parameters result in ill-defined Bayes factors (i.e. model marginal likelihood ratios) that depend on the ratio of two unspecified constants. As a result, the resulting posterior model probabilities prefer (with probability one) the smaller model regardless of the information in the data (see Bartlett, 1957). Given the difficulties of implementing these methods, BMA is typically based on proper and partly non-informative priors.

The priors we use are so-called Zellner's g-Priors, which are standard non-informative priors for BMA and are common for all the models evaluated. This corresponds to:

$$p(\sigma) = h^{-1}; \tag{4.3}$$

$$p(\beta_j \mid \sigma) \sim N(0_{m_j}, h^{-1}(gZ_j^{'}Z_j)^{-1}); \tag{4.4}$$

$$g = N \tag{4.5}$$

We choose Unit Information Prior (g-UIP) proposed by Kass and Wasserman (1995). Choosing g=N leads to Bayes factors that behave like Bayesian Information Criterion (BIC), and makes the results quite close to those of Frequentist Model Averaging. Eicher et al. (2011) compare estimates using different prior assumptions and conclude that g-UIP prior usually outperforms other commonly used priors.

Each model M_j depends upon parameters β_j, where their posterior is obtained as:

$$g\left(\beta^j \mid y, M_j\right) = \frac{f(y \mid \beta^j, M_j) g(\beta^j \mid M_j)}{f(y \mid M_j)} \propto f(y \mid \beta^j, M_j) g(\beta^j \mid M_j) \tag{4.6}$$

Although marginal likelihoods of models may be irrelevant for the posterior calculation, they are the measures of fit and are useful for posterior model comparison. They can be obtained:

$$f(y \mid M_j) = \int f(y \mid \beta^j, M_j) g(\beta^j \mid M_j) d\beta^j \tag{4.7}$$

BMA is a framework that allows to average across those models weighting by their posterior model probabilities, which are measures of their goodness of fit.

We set prior model probabilities, $P(M_j)$, equal across all the models. Given the prior, we can calculate the posterior model probability using Bayes rule as:

$$P\left(M_j \mid y\right) = \frac{f(y \mid M_j) P\left(M_j\right)}{f(y)} \tag{4.8}$$

Now we are ready to calculate any function of interest summing up our posterior estimates using posterior model probabilities as weights:

$$E[g(\beta)\,|\,y] = \sum_j E[g(\beta)\,|\,y, M_j]^* p(M_j\,|\,y) \quad (4.9)$$

Using this we derive the posterior mean, standard deviation as well as posterior inclusion probability, $E[g(\beta)\,|\,y] = p(\beta\,|\,y)$.

Those expressions for marginal likelihoods, posteriors of parameters and posterior model probabilities are standard, as in, e.g., Fernandez, Ley, and Steel, 2001b.

The problem with the model is that with m available variables, the researcher has to choose between 2^m potential models, which is potentially a huge number. It is also clear that the inclusion of all variables would lead to massive losses in precision as a consequence of the in-sample overfitting. Sequentially excluding some of the regressors based on their significance is also suboptimal, due to the pre-test problem where significance levels have to be adjusted each time after excluding irrelevant variables.

As noted by Koop (2003), the basic idea of Bayesian model averaging is relatively straightforward: when there is model uncertainty, the researcher should not base inference on a single model, but rather average over all models using posterior model probabilities as weights. However, implementing model averaging is computationally demanding, since the number of models to estimate is enormous. This paper uses the Bayesian Markov Chain Monte Carlo Model Composition (MC3) algorithm based on the g-prior to deal with computational problems and compute relevant statistics, such as posterior means and standard deviations. In our case, in an attempt to strike a balance between convergence and speed of execution, I choose 500 thousand trials out of which 20 thousand are burn-in iterations.

Overall, BMA features the following characteristics. It reduces the degree of subjectivity since it allows to make use of the data when deciding the appropriate econometric model and produces estimates based on all information contained in the data. At the same time, BMA is not a remedy against all problems that may arise in the estimation and, for example, endogeneity problems might lead the results to being inconsistent and even biased.

The estimation of our panel data BMA uses 'BMS' R package and is performed by removing fixed effects. It is worth noting that Moral-Benito (2012)'s Bayesian Averaging of Maximum Likelihood Estimates (BAMLE) approach generally performs well in dynamic panels. However, given the way we model crisis performance, the estimation using the fixed effects estimator produces consistent results.

In the next subsection, I describe the results of our BMA model.

4.2 Results

In this section, I describe the results of Bayesian model averaging and attempt to draw some of the policy-relevant conclusions.

Given that I use two methods to arrive at the cyclically-adjusted measure of fiscal response, I report both sets of results. Table 2 summarizes the results of the BMA model using the asset price adjustment to the fiscal response using Morris and Schuknecht's approach. Table 3 also reports the results but with the fiscal response measured using my own constructed action based dataset. The first three columns summarise the results of the baseline GDP per capita

specification when the dependent variable is measured as a growth rate, and the next three columns summarize the results of the model specification which accounts for potential international effects as in Cecchetti et al. (2011).

One of the critical quantities to take into account is the posterior inclusion probability (PIP). Usually, the variables with PIP greater than 50% are treated as important and statistically significant. Figure 2 plots the marginal posterior densities of the candidate variables, which allows us to assess the uncertainty around the parameter estimate as well as their significance level in a more formal way. As is evident from Figure 3, Bayesian Model Averaging has produced some shrinkage of the model parameters. Given our choice of uninformative priors, a-priori the model is equally likely to include any number of variables from 1 to 17. Most of the influential models a-posteriori are quite parsimonious and include only about 1-3 variables. Figure 4 illustrates the cumulative model probabilities and the variables that are included in an individual model specification.

Overall, the results indicate that predicting successful recovery is quite challenging. There are few macroeconomic preconditions that seem to have a statistically significant effect on the cross-country incidence of the recovery after the Great Recession. This is quite similar to the early indicators study of the financial crisis conducted by Rose and Spiegel (2011).

Our results suggest that for the successful recovery policy actions are much more important. In particular, we find that fiscal policy response has been instrumental. Posterior inclusion probabilities of the change in structural balance are close to 1 in almost every estimated model. Conditionally Positive Sign estimate, which for an arbitrary variable X mathematically can be expressed as $E[sign_X > 0 | X \text{ is included in } M_j]$, is also quite close to zero regardless of model specification. Tightening the fiscal budget over the recovery period leads to about one-to-one loss in GDP per capita. This means that any austerity actions during the recovery were unambiguously contractionary. When the variable is measured using my own fiscal dataset based on policy documents and the dependent variable is measured according to Cecchetti et al. (2011), the results for fiscal adjustment are similar but less conclusive. Our results may be interpreted as a strong rejection of Alesina's findings who proposed and supported the EFC hypothesis. They are much more in line with another large strand of literature represented by, e.g., IMF (2010) and Jordà and Taylor (2013). IMF (2010) finds that fiscal consolidation of 1 percent of GDP typically reduces output by about 0.5% over two years post implementation. Our result on fiscal adjustment is that they are even more damaging.

Even assuming that the findings of the EFC literature were methodologically correct, the authors did not make a clear distinction between the cases where the interest rates are close to the effective lower bound. For example, as Paul Krugman correctly pointed out in his blog, the Alesina-Ardagna analysis treats Japan in the 90s in the same way as a batch of countries in the 70s or 80s, when interest rates were much higher. Islam and Chowdhury (2012) also mention that fiscal adjustments were often combined either with loose monetary policy or exchange rate devaluation to offset recessionary effects of fiscal consolidations. It is quite easy to appreciate that neither of those options weren't available to some peripheral European economies included in the sample. Therefore, the result that austerity when interest rates are already close to zero lower bound is more damaging is not very surprising.

Turning to the monetary policy response effectiveness, the results here are much less conclusive. Although the change in policy rate variable appears as negative in a majority of the estimated models, the statistical significance of the result is quite limited with low posterior inclusion probabilities. This is because the impact of monetary policy on short-term growth is a complicated issue, which is often underestimated.

In theory, rate cuts should boost consumption and investment since they reduce the incentive to save and allow the real sector to borrow at a cheaper cost. Whether this actually happens in practice is a big question and depends on how leveraged the economy is. As the old metaphor says "You can lead a horse to water, but you can't make it drink." There are some other reasons why rate cuts may prove counterproductive. For example, existing loans arranged on a floating rate agreement become more expensive, just like a bond which grows in value when the rate drops. This raises the liquidation value of debt and is potentially very damaging when the debt levels are already high.

The effectiveness of the Quantitative Easing programmes has also been questioned in several studies. One of the large concerns is that the effectiveness is quite difficult to assess and this has to rely on some adjustments of their impact on long rates etc. According to Goodhart and Ashworth (2012), the initial round of QE was successful in reducing the borrowing costs, but their effect on the recovery in credit and monetary growth was quite limited. Moreover, subsequent rounds of QE were even less effective since interest rates were already very low by historical standards, which means that QE by construction runs into diminishing returns. They even suggested that further LSAP may run into negative returns. Martin and Milas (2012) provide additional sceptical reading of QE. They argue that QE has probably been effective in 2008-2009, preventing larger declines in output and asset prices. They note, however, that long rate reductions induced by QE may be limited and temporary with already low rates, so further rounds of LSAPs would not be effective.

Given that policy change appears with a negative sign in almost every specification, at least policy stimulus did not distort the economy and unconventional measures implemented by Fed and Bank of England might have been effective. However, much more rigour is required to test the effects of QE during the recovery, where a researcher would need to consider non-linear and time-varying effects.

Amongst precondition variables the set of variables that stands out with larger posterior inclusion probabilities is the one representing the financial development and banking sector indicators. The PIP for the financial deepening and growth of the private credit depending on specification reaches up to 50 percent. As discussed in the variable description section, there are some potentially conflicting effects coming through for the financial development variable, and it is generally difficult to evaluate which of those is more important prior to the estimation. What we find is that in every model specification where PIP is sufficiently large, those variables appear with a negative sign. Olafsson and Petursson (2010) found that the countries with larger banking systems and stronger global financial linkages have experienced deeper output and consumption contraction. Since the problems may have persisted even after their economies bottomed out, the financial deepening might have also adversely impacted the recovery.

Amongst other interesting findings to note is that the Debt ratio does not appear as significant in any of the specifications. On the one hand, this may be interpreted as further evidence against a highly debatable finding of Reinhart and Rogoff (2010). However, since we do not consider any thresholds in a formal way, there still may be some omitted non-linear effects.

As regards to other macroeconomic variables, the statistical significance of their effect is quite limited. This is similar to Rose and Spiegel, 2011, but quite in contrast with Olafsson and Petursson, 2010 and Cecchetti et al., 2011, possibly as a consequence of a different methodology used to estimate the model. Our result leads to a conclusion that during the recovery after the Great Recession it was policy response that played a key role rather than some macroeconomic preconditions. Of course, the finding is robust only to the extent of our advanced economies sample within the considered time period and this is by no-means suggesting that those variables are not important for the long-term growth.

In the next section, I attempt to test my results on robustness and sensitivity to the model specifications by appealing to several other approaches commonly applied in Bayesian econometrics.

4.3 Robustness and sensitivity analysis

This part explains the results of estimating the model using alternative specifications using our primary dependent variable and the fiscal policy response adjusted for asset price effects using Morris and Schuknecht's (2007) correction.

Table 4 includes the results of the estimated robustness specifications, which include OLS fixed effects, Stochastic Search Variable Selection and Bayesian least absolute shrinkage and selection.

Interestingly, despite some differences with respect to the estimates and standard deviations, the robustness checks confirm our BMA finding that the change in structural balance and financial deepening were the most influential determinants of recovery. Every model confirms our main finding that the fiscal tightening leads to about one-to-one reduction in growth, which is higher in magnitude than previously found in the literature.

Stochastic Search Variable Selection (SSVS) is a method that selects influential variables by eliciting their data-based prior distributions using hierarchical priors. In problems with many explanatory variables, it is common to expect a priori that only a small proportion of candidates are genuinely affecting the dependent variable.

In SSVS the prior is specified in the following way:

$$\beta \mid \gamma \sim (1-\gamma)N(0,\tau_0^2) + \gamma N(0,\tau_1^2) \qquad (4.10)$$

Where $\gamma = 0$ *or* $\gamma = 1$ and τ_0 is small and τ_1 is large. SSVS treats γ as unknown and estimates it using Bernoulli priors. This, in turn, determines variance for the β coefficient and whether the prior is loose or tight. If $\Pr(\gamma = 1 \mid \gamma) > \frac{1}{2}$ then we choose τ_1 and choose the unrestricted model, otherwise the prior is tightly shrunk to zero.

Intuitively, SSVS elicits the prior for a regression coefficient which depends upon a hyperparameter determining whether this coefficient's value is a priori tightly shrunk to zero. In the end, important variables are going to have larger posterior estimates of γ while unimportant ones have their values close to zero (those are specified in column 4 of table 2). SSVS proceeds by using a Gibbs sampler to indirectly sample from the multinomial posterior distribution on the set of possible subset choices. Important subsets are identified by their frequent appearance in the Gibbs sampler, which means that calculating a range of posterior model probabilities over the 2^m possible choices is not required. For the detailed description of the SSVS, the reader is referred to George and McCulloch (1993).

Overall, the SSVS results broadly confirm the BMA findings, to the effect that fiscal adjustment and financial deepening are identified as the most likely variables to have an impact on the post-crisis growth recovery. SSVS also finds some weak evidence on the monetary policy response and less significant effects of the majority of other variables.

I also conduct the estimation using Bayesian least absolute shrinkage and selection operator (Lasso). The frequentist LASSO was developed by Tibshirani (1996). Lasso estimates are often viewed as the estimates of the penalized least squares, achieved by:

$$\min_{\beta}(y - X\beta)'(y - X\beta) + \lambda\sum_{j=1}^{p}\left|\beta_j\right| \tag{4.11}$$

For some $\lambda \geq 0$.

Park and Casella (2008) showed that Lasso estimates may be interpreted as posterior mode estimates when the regression parameters have independent and identical hierarchical Laplace priors of the following form:

$$\pi(\beta \mid \sigma^2) = \prod_{j=1}^{p}\frac{\lambda}{2\sqrt{\sigma^2}}e^{-\lambda|\beta_j|}/\sqrt{\sigma^2} \tag{4.12}$$

And the non-informative marginal prior $\pi(\sigma^2) = 1/\sigma^2$.

Overall, BMA (or BMS) estimation can be challenging since they require the evaluation of the entire model space using MC3. SSVS and LASSO are just two of many alternative ways to arrive at an optimal parsimonious model. These methods employ hierarchical priors and allow the estimation of one model and then depending on the posterior estimates of hyperparameters conduct model selection. This is useful since BMA and BMS require MC3, evaluating entire model space, which is computationally demanding.

The results of this model are slightly more disappointing since all of the included variables, except for the change in structural balance, are centered around zero. On the one hand, this is broadly similar to the results of BMA, but on the other hand, may be due to the limitations of Bayesian Lasso estimation in small samples, where the lack of unimodality slows the convergence of Gibbs sampler which in turn leads to excessive parameter shrinkage. However, most importantly LASSO also confirms our finding of unambiguously contractionary austerity during the recovery.

5. Conclusion

Following the Great Recession, most developed countries recovered much more slowly than after the previous crises. At the same time, there was a significant difference in the speed of recovery between different economies. With a significant amount of research conducted on the determinants of the exposure to the crisis, this paper focuses on the importance of policy and fundamentals in explaining the recovery after the Great Recession.

As a response to the crisis, most of the countries in our sample drastically lowered their policy rates. Central banks faced with the effective lower bound for their nominal policy rates had to consider other options to bring the economies back to growth. Some central banks responded using so-called unconventional monetary measures. I make use of Krippner's shadow short rate database which maps the effect of unconventional measures on short rates. Then it takes adjusted short rates as a measure of policy rates in the US and UK.

Given the pro-cyclicality of commonly used structural balance measures, we make use of two approaches in an attempt to correct it. First, using a statistical approach, as proposed by Morris and Schuknecht (2007), I account for the effect of asset prices, as a measure of wealth, on government revenue. Second, I utilise the Action-based fiscal policy database, which I constructed in another study.

Even when the policy response has been measured, there remains significant uncertainty about which model to use and what variables might have played a role in the recovery. I use Bayesian Model Averaging, which removes subjectivity on the appropriate econometric model and allows the inference to be based on all the information contained in the data. The findings are then tested for robustness using alternative methods, such as Bayesian Model Selection (BMS), Stochastic Search Variable Selection (SSVS) and Bayesian least absolute shrinkage and selection operator (LASSO).

Generally, the results suggest that predicting the recovery performance by looking at macroeconomic variables is challenging. Out of 17 candidate variables the most likely posterior model size ranges from 1 to 3. One of the conclusions is that the recovery after the Great Recession has been even more challenging to predict than those following past recessions. Hong and Tornell (2005), Aizenmann and Pasricha (2012) and Jovanovic (2012) in their studies found some evidence that such variables as the level of international reserves, macroprudential regulation, and domestic credit ratio might have been important recovery determinants. Amongst those variables I find only the effect of financial development indicators to be significant and stress that the recovery was determined largely by the size of fiscal response. The evidence on monetary response is weaker despite that we find a conditionally negative sign of the change in the policy rate variable in almost every specification. Overall, the countries where policy makers were more decisive and proactive in stimulating the economy in the traditional Keynesian sense have recovered faster after the Great Recession. This is an argument which is in a sharp contrast with Alesina's expansionary austerity hypothesis, but in line with another large strand of literature represented by e.g. Jordà and Taylor (2013).

There are some similarities between our findings and those found in the literature relating to the Great Recession. Rose and Spiegel (2011), for example, argued that predicting the extent of exposure to the financial crisis 2008 would be extremely difficult given a country's fundamentals. Predicting recovery would also be very challenging by looking at macroeconomic preconditions.

There remains much scope for future research. It would be interesting to check what was important in shaping inflation expectations and what influenced consumer confidence or stimulated consumption recovery. We have not formally considered a range of thresholds of the Debt ratio, and possibly our model omits some important non-linear effects.

The methods used to arrive at the results described here rely on the strict exogeneity of the included regressors. Therefore, potential endogeneity of variables such as the policy response has not been treated in a rigorous way here. Although using lagged variables theoretically helps, it may not be sufficient if the expectations of future economic performance are embodied into lagged variables. Endogeneity in Bayesian Model Averaging is still an area of open research. For a short survey of the literature, the reader is referred to Moral-Benito (2012).

Also, the model may be transformed into Dynamic model averaging (developed by Raftery (2010)), where the models' weights evolve over time. This could be an exciting application of DMA as one would be able to see if there was a difference in effects of various QE rounds (as in, for example, Goodhart and Ashworth (2012)). Such an approach to our problem would also allow us to examine which variables were significant at initial stages of recovery and which were more critical for the sustained recovery.

6. Appendix

Table 2.1 Growth rates of countries in the sample

	2008	2009	2010	2011	2012	2013	2014	2015
Austria	-1.58	-0.77	1.67	1.08	0.28	0.15	-0.93	0.03
Belgium	-2.76	-0.02	1.34	0.38	-0.79	0.22	0.86	1.03
Canada	-1.04	-2.94	2.43	2.10	-0.50	1.93	1.28	0.18
Denmark	-4.93	-3.67	2.27	0.04	-0.66	0.11	0.59	1.04
France	-2.50	-1.36	1.67	0.98	-0.44	0.51	-0.29	0.91
Germany	-1.54	-2.73	4.44	2.30	-0.09	1.06	1.17	0.96
Greece	-1.81	-3.06	-9.62	-10.09	-3.89	-1.27	1.69	1.69
Iceland	-3.72	-6.26	-2.15	1.23	0.61	4.01	0.53	5.06
Ireland	-9.42	-4.68	1.92	3.27	-1.72	2.66	5.69	6.66
Italy	-4.28	-3.18	1.76	-1.40	-3.30	-1.49	-0.51	0.67
Luxembourg	-8.63	-0.89	3.96	-1.64	-1.24	0.79	4.17	1.34
Netherlands	-1.17	-3.26	1.47	-0.57	-1.57	0.61	1.13	1.79
Norway	-2.48	-2.69	-0.26	-0.04	0.38	0.36	1.84	0.39
Portugal	-2.18	-1.37	1.40	-3.29	-4.09	2.41	1.10	2.02
Spain	-2.61	-3.52	0.15	-2.13	-3.03	0.14	2.27	3.17
Sweden	-5.97	-2.75	6.78	-1.22	-0.14	1.40	1.50	2.28
Switzerland	-1.78	-1.77	1.22	0.28	0.38	0.64	0.68	0.05
Turkey	-8.09	3.29	8.19	3.44	-0.09	3.47	1.04	3.31
United Kingdom	-5.05	-2.03	0.94	1.29	0.34	2.11	2.28	1.87
United States	-3.72	-1.11	1.90	0.92	0.53	1.68	1.71	1.95

Table 2.2 Results of Bayesian Model Averaging. Model specification with fiscal response measured using Morris and Schucknecht's asset price adjustment to IMF Data.

	Recovery			Recovery measured as CYK		
	Posterior mean/stdev	Conditionally Positive Sign	PIP	Posterior mean/stdev	Conditionally Positive Sign	PIP
Crisis	0.000	0.304	0.012	0.000	0.711	0.018
	0.006			0.008		
FinDeep	-0.032	0.000	0.213	-0.0297	0.000	0.473
	0.067			0.035		
Bank Capital to Assets (%)	0.000	0.990	0.014	0.000	0.983	0.018
	0.006			0.025		
PrivCredit_2009	0.000	0.677	0.014	0.000	0.012	0.020
	0.000			0.002		
PrivateCredit_diff	0.000	1.000	0.021	-0.077	0.000	0.317
	0.005			0.125		
IT	0.000	0.310	0.014	0.000	0.836	0.018
	0.038			0.156		
CB Indep	0.000	0.697	0.013	0.000	0.000	0.019
	0.001			0.005		
Legal Structure and Security of Property Rights	0.000	0.659	0.013	0.000	0.000	0.020
	0.018			0.081		
Credit Market Regulations	0.000	0.732	0.013	0.000	0.066	0.018
	0.024			0.104		
Trade	0.000	0.037	0.014	0.000	0.385	0.016
	0.002			0.001		
FDI	0.000	0.718	0.015	0.000	0.702	0.018
	0.003			0.012		
CAB	0.000	0.000	0.013	0.000	0.416	0.018
	0.003			0.012		
Debt	0.000	0.997	0.013	0.000	0.997	0.018
	0.001			0.003		
IntReserves	0.000	0.997	0.013	0.000	0.944	0.018
	0.212			0.908		
Structural balance	0.000	0.288	0.013	0.000	1.000	0.019
	0.003			0.014		
Change in Structural balance	-1.024***	0.000	1.000	-2.405***	0.000	0.990
	0.155			0.606		
Policy rate change	0.000	0.296	0.016	-0.001	0.286	0.019
	0.013			0.053		
N	120					
K	17					

Dependent variables are recovery growth rates after the crisis of GDP per capita (on the left) dependent variable, on the right Cecchetti et al. (2011) dependent variable. The statistically significant coefficients are marked with asterisk (with PIP larger than 0.5).

Table 2.3 Results of Bayesian Model Averaging. Model specification with fiscal adjustment measured using my own action-based fiscal action dataset.

	Recovery			Recovery measured as CYK		
	Posterior mean/stdev	Conditionally Positive Sign	PIP	Posterior mean/stdev	Conditionally Positive Sign	PIP
Crisis	0.000	0.016	0.011	0.000	0.653	0.011
	0.006			0.006		
FinDeep	-0.021	0.000	0.133	-0.335	0.000	0.460
	0.059			0.040		
Bank Capital to Assets (%)	0.000	0.986	0.013	0.000	0.903	0.010
	0.007			0.020		
PrivCredit_2009	0.000	0.990	0.012	0.000	0.010	0.008
	0.000			0.001		
PrivateCredit_diff	0.000	0.020	0.013	-0.041	0.000	0.162
	0.004			0.102		
IT	-0.001	0.028	0.014	0.000	0.647	0.011
	0.042			0.132		
CB Independence	0.000	0.985	0.013	0.000	0.011	0.011
	0.001			0.004		
Legal Structure	0.000	0.026	0.012	0.000	0.006	0.010
	0.020			0.061		
Credit Market Regulations	0.000	0.987	0.011	0.000	0.037	0.010
	0.025			0.082		
Trade Openess	0.000	0.976	0.013	0.000	0.332	0.010
	0.001			0.001		
FdiRestrictivenessIndex	0.000	0.981	0.012	0.000	0.374	0.011
	0.003			0.010		
CurrentAccountBalance	0.000	0.000	0.014	0.000	0.385	0.010
	0.003			0.009		
Debt	0.000	0.979	0.014	0.000	0.989	0.010
	0.001			0.002		
IntReserves	-0.004	0.025	0.013	0.000	0.967	0.010
	0.234			0.703		
Structural balance	-0.004	0.421	0.021	0.001	0.764	0.011
	0.043			0.055		
Change in Structural balance	-0.436***	0.000	0.965	-0.001	0.392	0.011
	0.134			0.043		
Change in Policy rate	0.000	0.165	0.013	-0.004	0.000	0.014
	0.013			0.060		
N	120					
K	17					

Dependent variables are recovery growth rates after the crisis of GDP per capita (on the left) dependent variable, on the right Cecchetti et al. (2011) dependent variable. The statistically significant coefficients are marked with asterisk (with PIP larger than 0.5).

Table 2.4 Results of estimation using alternative methodologies (e.g. SSVS and LASSO)

	Fixed effects	SSVS		LASSO	
	mean/sd	mean/sd	p(γ=1|y)	mean/sd	p(τ=1|y)
Crisis	0.000	0.000	0.1241	0.006	0.014
	0.119	0.033		0.010	
FinDeep	-0.016***	-0.011***	0.7741	0.001	0.019
	0.007	0.078		0.004	
Bank Capital to Assets (%)	0.000	0.000	0.122	0.002	0.005
	0.121	0.033		0.003	
PrivCredit_2009	0.000	0.000	0.1035	0.001	0.002
	0.010	0.002		0.001	
PrivateCredit_diff	0.026	0.007	0.253	0.019	0.036
	0.029	0.017		0.014	
IT	0.000	0.000	0.1483	0.008	0.015
	0.563	0.187		0.023	
CB Independence	0.000	0.001	0.1401	0.001	0.018
	0.018	0.006		0.003	
Legal Structure	0.000	0.000	0.1122	0.002	0.005
	0.505	0.129		0.004	
Credit Market Regulations	0.000	0.000	0.117	0.002	0.006
	0.576	0.150		0.004	
Trade Openess	0.000	0.000	0.145	0.000	0.013
	0.043	0.002		0.002	
FdiRestrictivenessIndex	0.000	0.002	0.1197	0.021	0.026
	5.910	1.571		0.075	
CurrentAccountBalance	0.000	0.000	0.1063	0.002	0.007
	0.081	0.019		0.004	
Debt	0.000	0.000	0.1106	0.001	0.002
	0.017	0.004		0.001	
IntReserves	0.000	0.004	0.1298	0.020	0.026
	4.146	1.206		0.073	
Structural balance	0.000	0.000	0.1422	0.003	0.007
	0.058	0.018		0.004	
Change in Structural balance	-1.010***	-0.957***	1	-0.919***	0.561
	0.165	0.153		0.061	
Change in Policy rate	0.026	-0.002	0.1936	0.003	0.007
	0.105	0.049		0.006	
Adjusted R-squared	0.2073				
N	120	120		120	
K	17	17		17	

Alternative regression results with the primary dependent variable and fiscal response measured using the IMF data with Morris and Schucknecht's asset price adjustment. The statistically significant coefficients are marked with asterisk (in case of Bayesian methods judging by posterior probability of the hyperparameter).

Table 2.5 IMF Structural Balances

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria	-3.15	-3.26	-3.23	-3.55	-2.76	-2.03	-1.36	-0.68	-0.83
United States	-4.01	-5.88	-7.59	-9.45	-8.07	-6.17	-4.08	-3.59	-3.07
United Kingdom	-5.39	-6.74	-9.73	-8.05	-5.80	-5.56	-3.64	-4.34	-3.59
Germany	-0.82	-0.75	-0.86	-2.21	-1.26	-1.26	0.39	0.60	0.47
Italy	-3.10	-3.83	-4.17	-3.68	-3.81	-1.48	-0.45	-0.79	-0.49
Spain	0.46	-5.60	-9.46	-7.78	-7.01	-3.74	-3.00	-2.49	-2.27
Greece	-10.45	-13.86	-18.63	-12.13	-8.60	-2.89	0.30	-0.88	-0.68
Denmark	3.22	1.36	-1.43	-2.48	-2.20	-2.21	-1.80	-2.13	-2.02
Belgium	-1.10	-2.07	-4.26	-3.89	-4.05	-3.46	-2.84	-2.89	-2.23
Netherlands	-0.15	0.63	-3.00	-2.82	-2.50	-1.54	0.33	0.23	-0.16
Canada	0.49	-0.82	-2.48	-3.73	-3.17	-2.51	-2.22	-1.65	-1.03
Portugal	-3.77	-5.22	-8.62	-8.14	-6.15	-3.02	-2.04	-1.14	-1.72
France	-3.70	-4.01	-5.66	-5.81	-4.71	-3.78	-2.90	-2.37	-2.08
Ireland	-9.86	-13.14	-11.01	-8.85	-6.12	-4.60	-3.68	-2.48	-1.42
Sweden	1.41	0.78	-0.09	0.73	0.12	-0.01	-0.61	-1.09	-1.04
Switzerland	0.35	0.84	0.85	0.23	0.41	0.24	0.08	0.08	0.00
Iceland	2.85	-4.43	-9.99	-4.20	-4.03	-2.16	-1.45	-1.88	-1.15
Turkey	-3.86	-4.02	-3.37	-2.97	-2.68	-3.58	-2.95	-2.14	-1.96
Norway	-3.33	-3.41	-5.67	-5.54	-4.65	-5.11	-5.33	-6.14	-6.97
Luxembourg	2.09	2.20	1.26	-0.51	0.12	1.21	1.39	0.38	-0.32

Table 2.6 IMF Structural Balances adjusted for asset price effects using Morris and Schuknecht's (2007) methodology

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria	-3.46	-2.51	-1.42	-1.55	-0.53	1.38	2.05	2.90	2.76
United States	-4.18	-5.78	-7.50	-9.27	-7.89	-5.98	-4.00	-3.55	-3.04
United Kingdom	-5.22	-7.16	-10.11	-8.68	-7.05	-6.86	-4.98	-5.01	-4.25
Germany	-1.03	-0.53	-0.39	-1.94	-1.06	-1.06	0.54	0.84	0.71
Italy	-3.51	-3.53	-3.41	-3.15	-3.35	-1.25	-0.71	-1.65	-1.35
Spain	0.29	-5.76	-9.60	-8.31	-8.27	-5.46	-5.43	-5.19	-4.97
Greece	-11.34	-13.21	-17.37	-11.40	-8.32	-3.87	-1.81	-2.99	-2.79
Denmark	3.53	0.15	-2.93	-4.54	-5.43	-5.68	-5.49	-6.77	-6.66
Belgium	-1.49	-1.68	-3.31	-3.06	-3.16	-2.54	-2.17	-2.40	-1.74
Netherlands	-0.57	0.65	-2.97	-3.34	-3.49	-3.34	-2.15	-2.25	-2.64
Canada	0.49	-0.86	-2.30	-3.63	-3.11	-2.42	-2.06	-1.53	-0.91
Portugal	-3.77	-5.22	-8.62	-8.14	-6.15	-3.02	-2.04	-1.14	-1.72
France	-3.82	-3.92	-5.53	-5.43	-4.24	-3.43	-2.88	-2.69	-2.39
Ireland	-10.55	-13.13	-11.25	-10.17	-8.78	-7.80	-6.97	-5.32	-4.26
Sweden	1.29	0.85	1.26	1.97	0.89	1.23	0.99	1.32	1.37
Switzerland	0.23	1.11	1.54	1.02	1.47	1.53	1.29	1.29	1.13
Iceland	-13.73	16.40	7.66	13.03	14.34	16.66	16.98	17.06	17.79
Turkey	-3.86	-4.02	-3.37	-2.97	-2.68	-3.58	-2.95	-2.14	-1.96
Norway	-3.57	-3.24	-4.88	-5.10	-4.45	-4.85	-5.04	-5.75	-6.57
Luxembourg	1.97	2.49	2.53	0.54	1.60	3.10	3.56	2.85	2.16

Table 2.7 Data definitions and sources

Variable	Description	Source
Recovery performance	The growth rate of per capita GDP from 2010 to 2015.	IMF International Financial Statistics and author's calculations
Recovery performance according to Cecchetti, King, Yetman (2011)	The sum of the deviations from the principal component of the GDP per capita measure within a particular year during the recovery period from 2010 to 2015.	IMF International Financial Statistics and author's calculations
Crisis performance	Defined as in the same way as the dependent variable using data from 2008 to 2009.	IMF International Financial Statistics and author's calculations
Financial deepening index	The index is encompassing multiple dimensions of a country's financial markets and institutions development.	Svirydzenka, K. (2016) (2015) database
Bank capital to assets (%)	The ratio of bank capital and reserves to total assets. Capital and reserves include funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments.	World Bank Global Financial Development Database
Private Credit to GDP (%)	The financial resources provided to the private sector by domestic money banks as a share of GDP. Domestic money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits.	World Bank Global Financial Development Database
IT dummy	Indicator variable representing whether the country is using inflation targeting as their monetary framework.	Handbook of Bank of England (2012)
Central bank independence	Measured as the Central Bank Autonomy Score. The score depends on several dimensions of political and economic independence.	Laurens et al. (2007) database

Legal Structure and Security of Property Rights	Index measured on the scale from 0 to 10. 10 Indicates perfect Legal Structure and Security of Property Rights.	Economic Freedom of The World database by Fraser Institute. Obtained from Rose and Spiegel (2011).
Credit Market Regulations	Index measured on the scale from 0 to 10. 10 Indicates perfect Credit Market Regulations	Economic Freedom of The World database by Fraser Institute. Obtained from Rose and Spiegel (2011).
Trade Openness	Calculated as the sum of imports and exports as a fraction of GDP	OECD Statistics
FDI restrictiveness index	The measure of statutory restrictions on foreign direct investment.	OECD Statistics
Current Account Balance	A country's current account balance measured as a percentage of GDP.	World Economic Outlook IMF
Debt ratio	General government gross debt as a percentage of GDP.	World Economic Outlook IMF
International reserves	A country's international reserves measured as a percentage of GDP.	World Bank Global Financial Development Database
Fiscal adjustment using Morris and Schuknecht (2007) asset price adjustment	IMF Structural Balances striped out from asset price effects.	IMF International Financial Statistics and author's calculations
Fiscal adjustment using my own Action-based fiscal policy dataset	Fiscal stance scores in Structural Balance from 2010 to 2015 using my own constructed database.	IMF International Financial Statistics and author's calculations based on Budget Reports, Budget Speeches, Stability and Convergence Programmes submitted by the authorities to the European Commission, IMF Article IV consultation reports and OECD Economic Surveys.
Policy rate change	The change in the benchmark policy rate. In the case of UK and US, shadow rate estimates are used.	IMF IFS and shadow short rate estimates from Leo Krippner's database

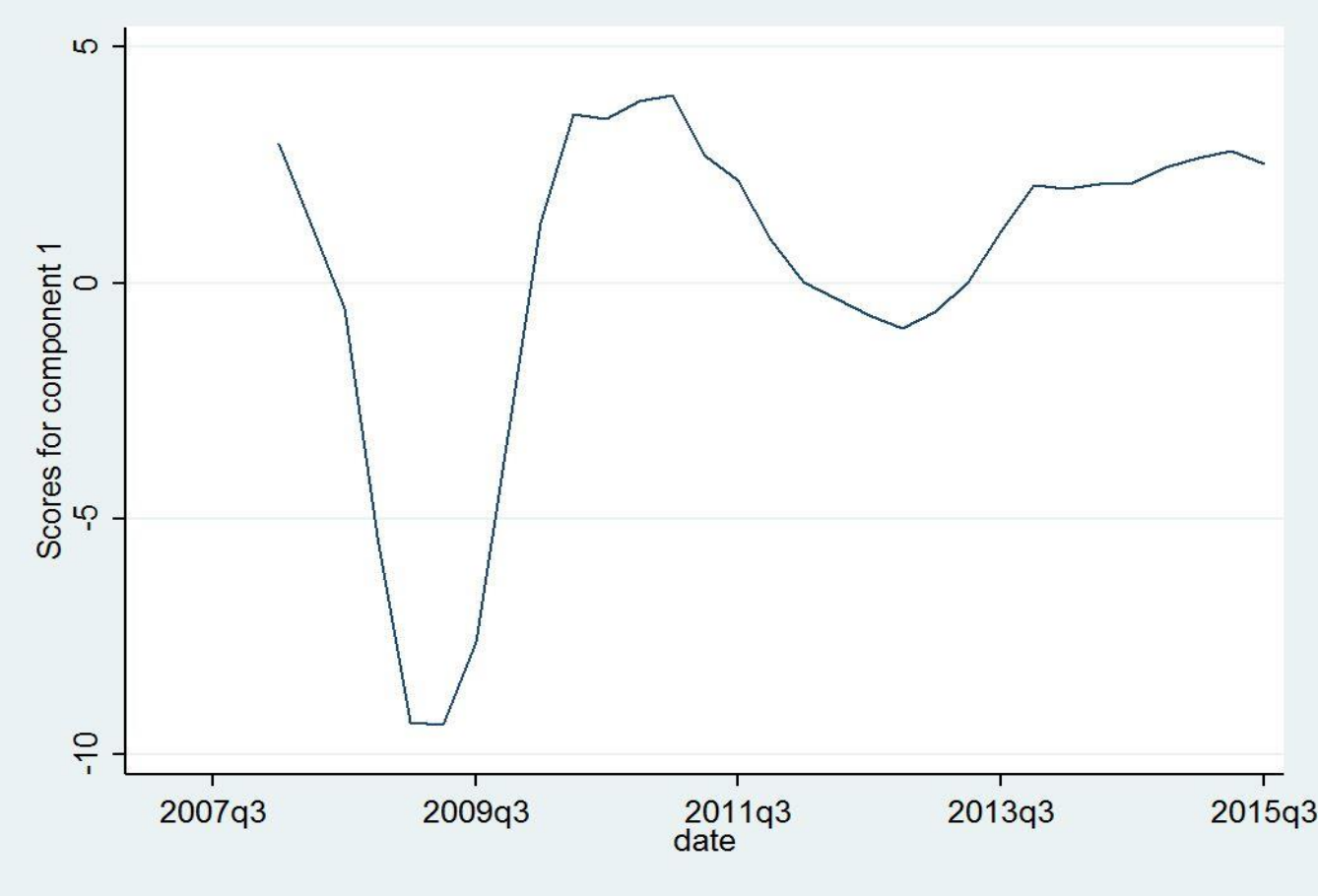
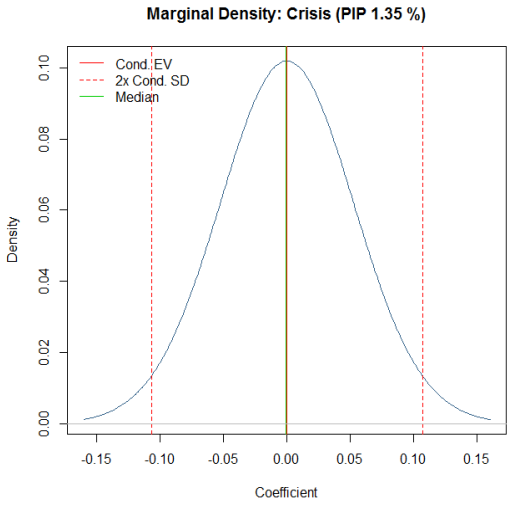
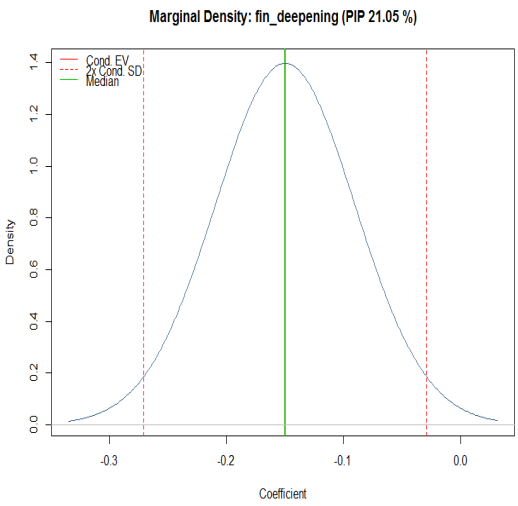
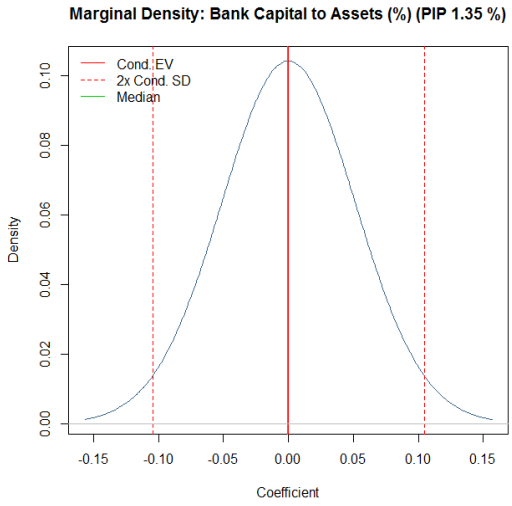


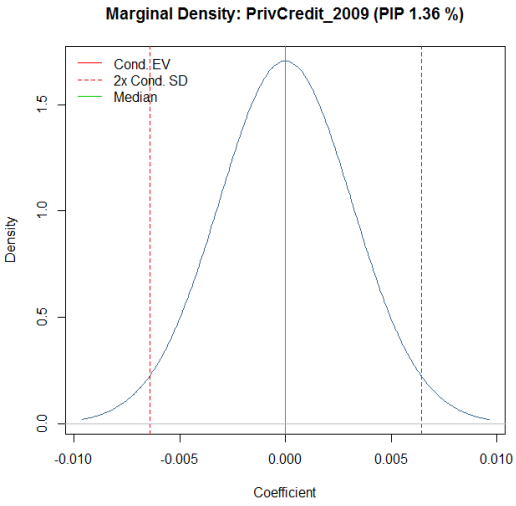
Figure 2.1. First principal component during the recovery period.

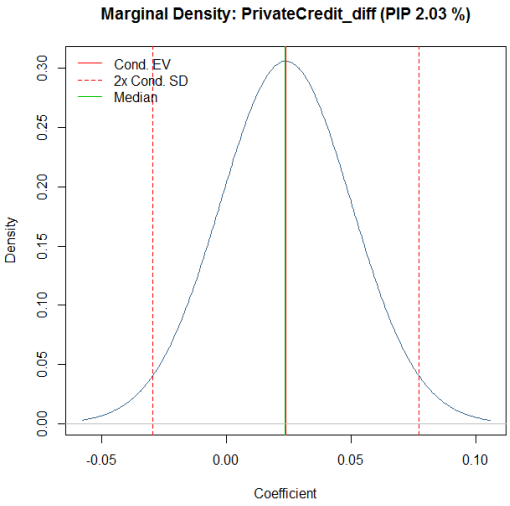
The deviation from this international growth rate trend is interpreted as the idiosyncratic country performance. This methodology follows Cecchetti et al. (2011).

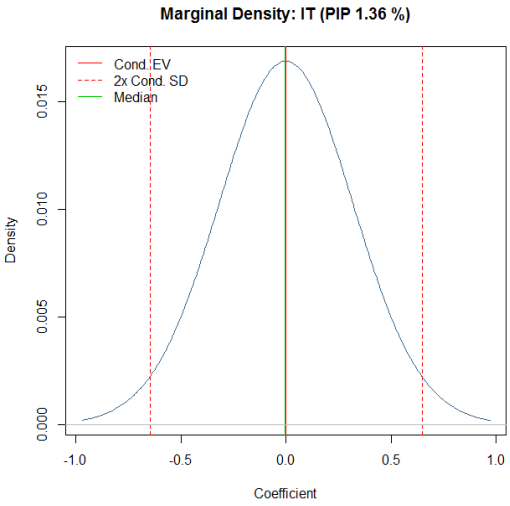

Marginal Density: Crisis (PIP 1.35 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient

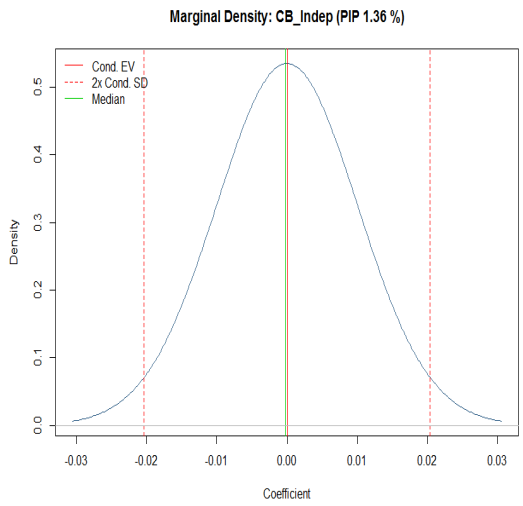

Marginal Density: fin_deepening (PIP 21.05 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient

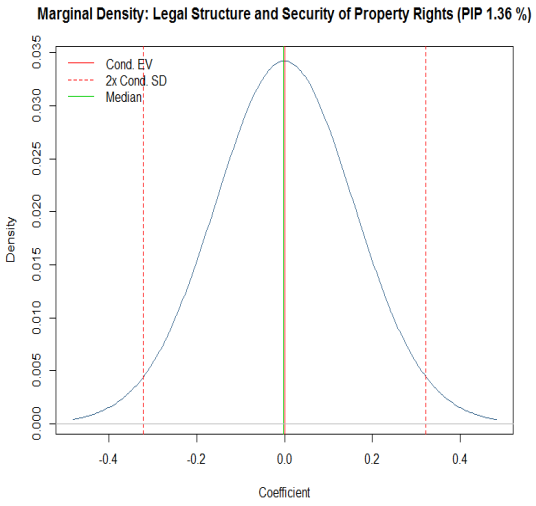

Marginal Density: Bank Capital to Assets (%) (PIP 1.35 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient

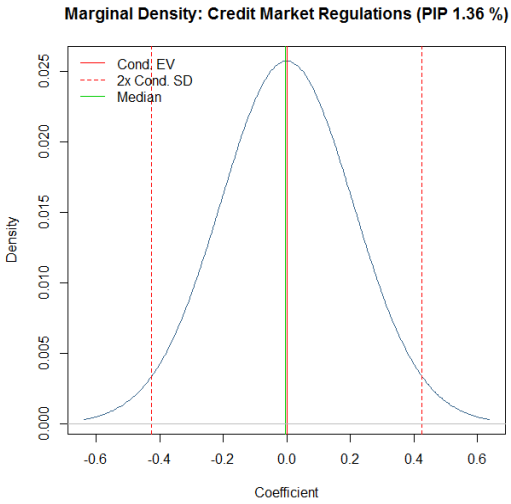

Marginal Density: PrivCredit_2009 (PIP 1.36 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient

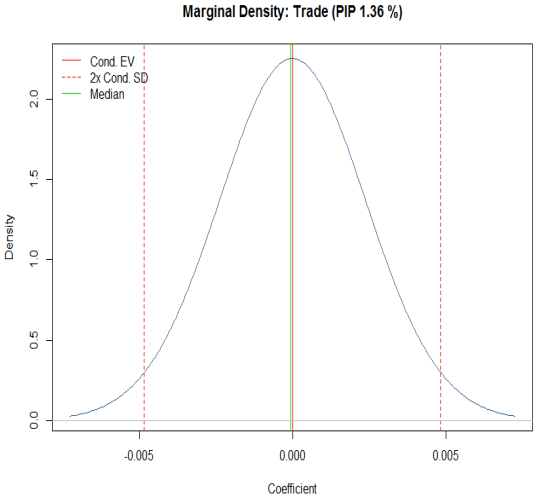

Marginal Density: PrivateCredit_diff (PIP 2.03 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient

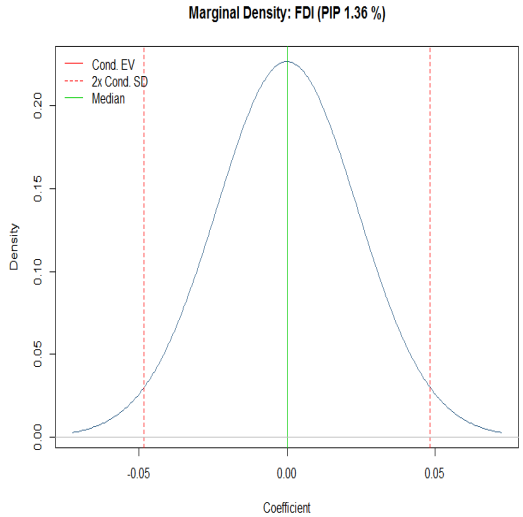

Marginal Density: IT (PIP 1.36 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient

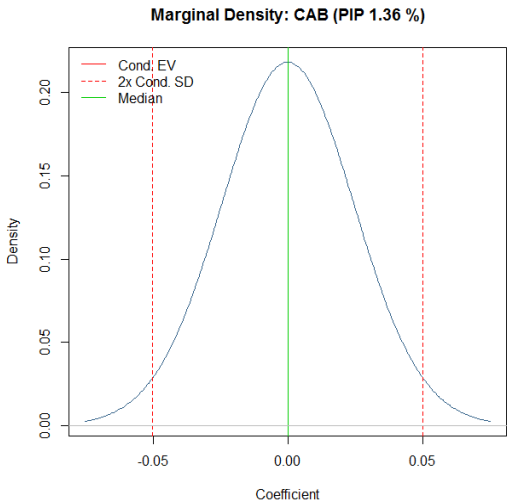

Marginal Density: CB_Indep (PIP 1.36 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient


Marginal Density: Legal Structure and Security of Property Rights (PIP 1.36 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient


Marginal Density: Credit Market Regulations (PIP 1.36 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient


Marginal Density: Trade (PIP 1.36 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient


Marginal Density: FDI (PIP 1.36 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient


Marginal Density: CAB (PIP 1.36 %)
Cond. EV
2x Cond. SD
Median
Density
Coefficient

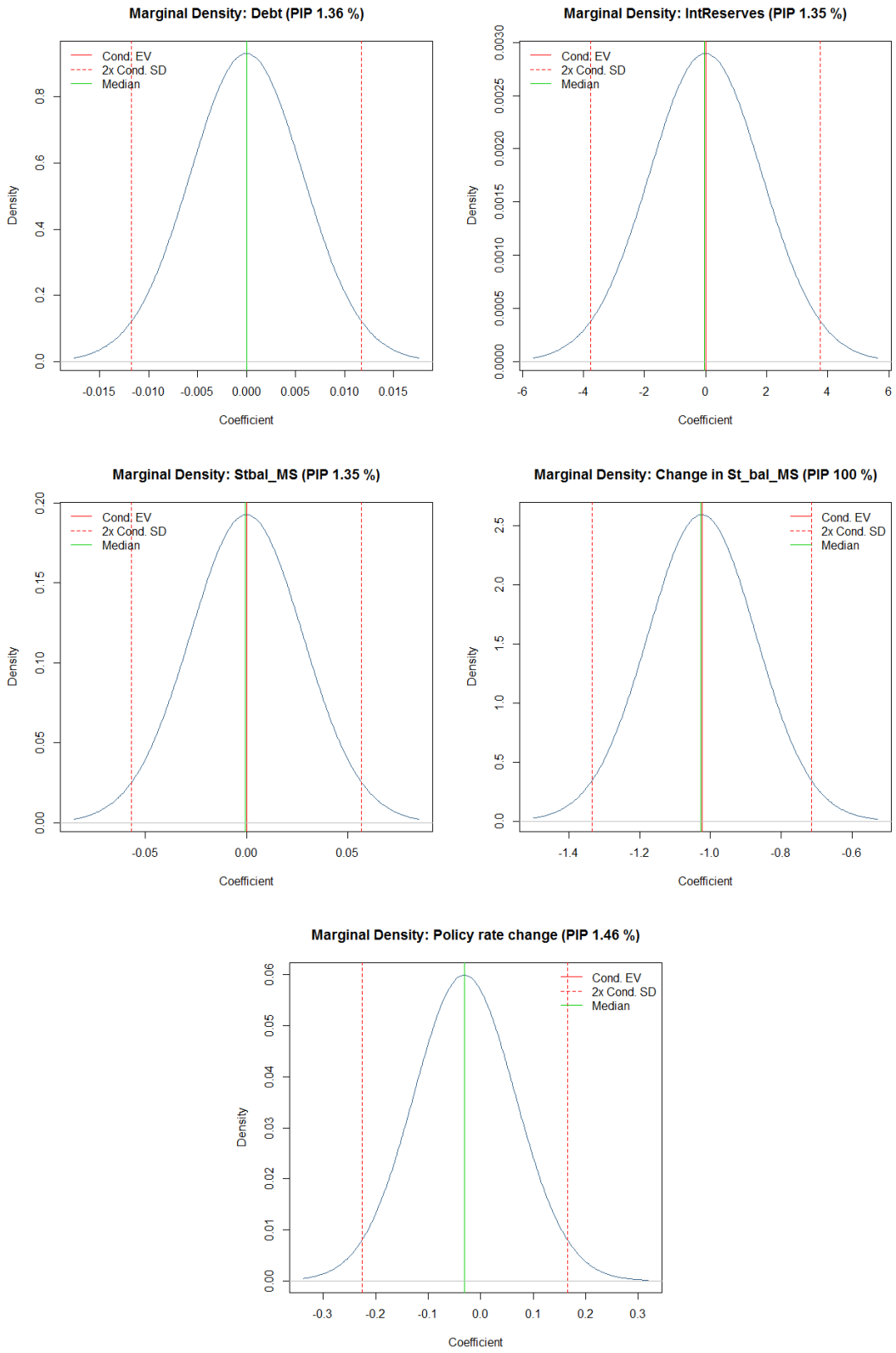


Figure 2.2. Posterior marginal densities of the variables included in the Bayesian Model Averaging.

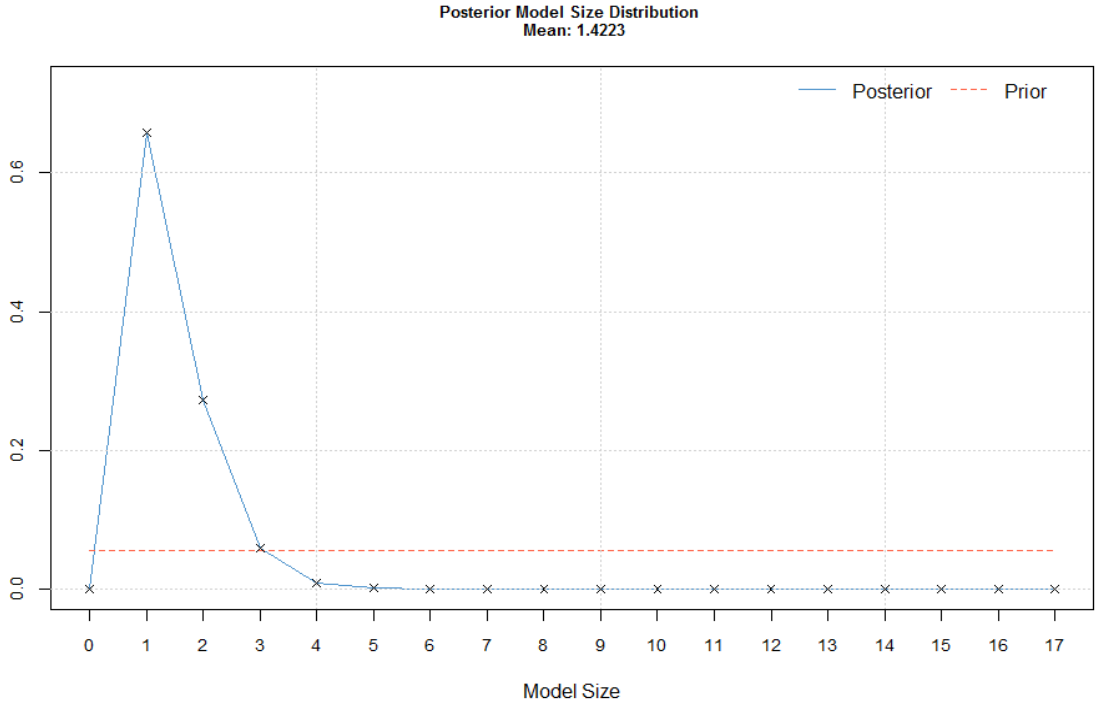


Figure 2.3. Uninformative prior and Posterior model size distribution.

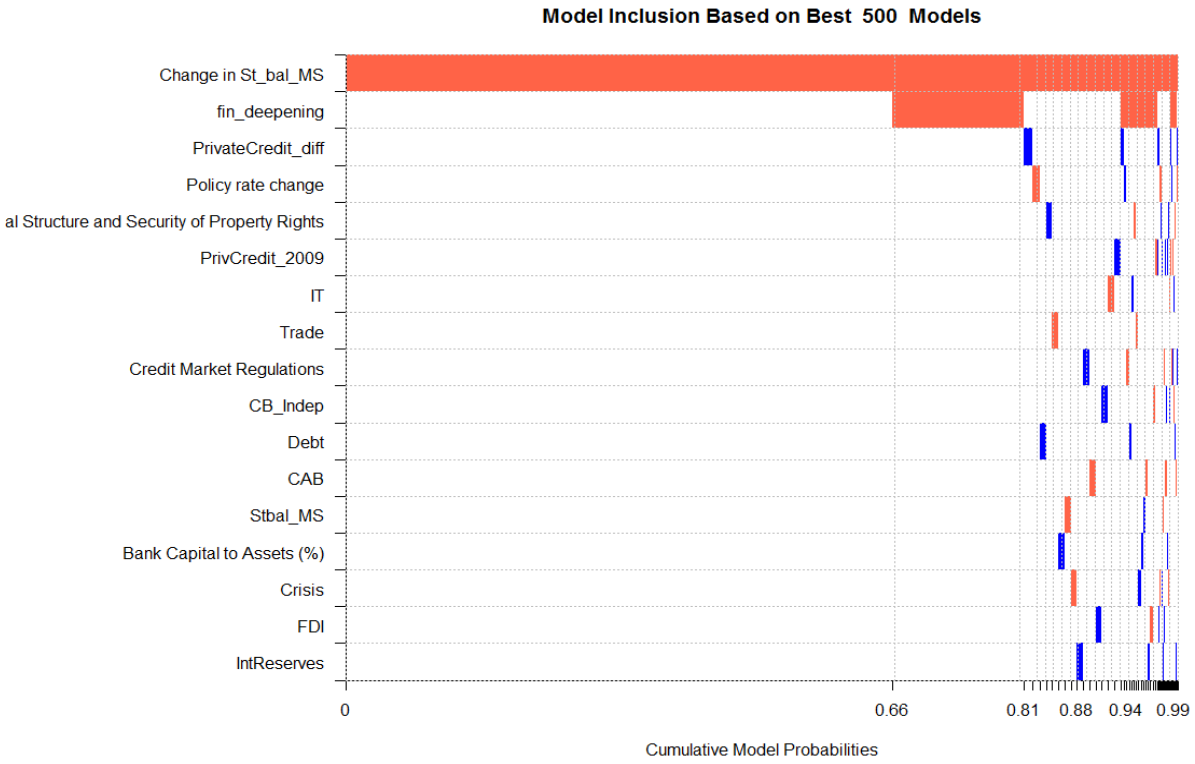


Figure 2.4. Cumulative Model Probabilities and Included Regressors.

Best models are to the left. Doted lines indicate a change of the model. Blue regions indicate that the variable appears in a model with a conditional negative sign; red regions indicate conditionally positive sign.

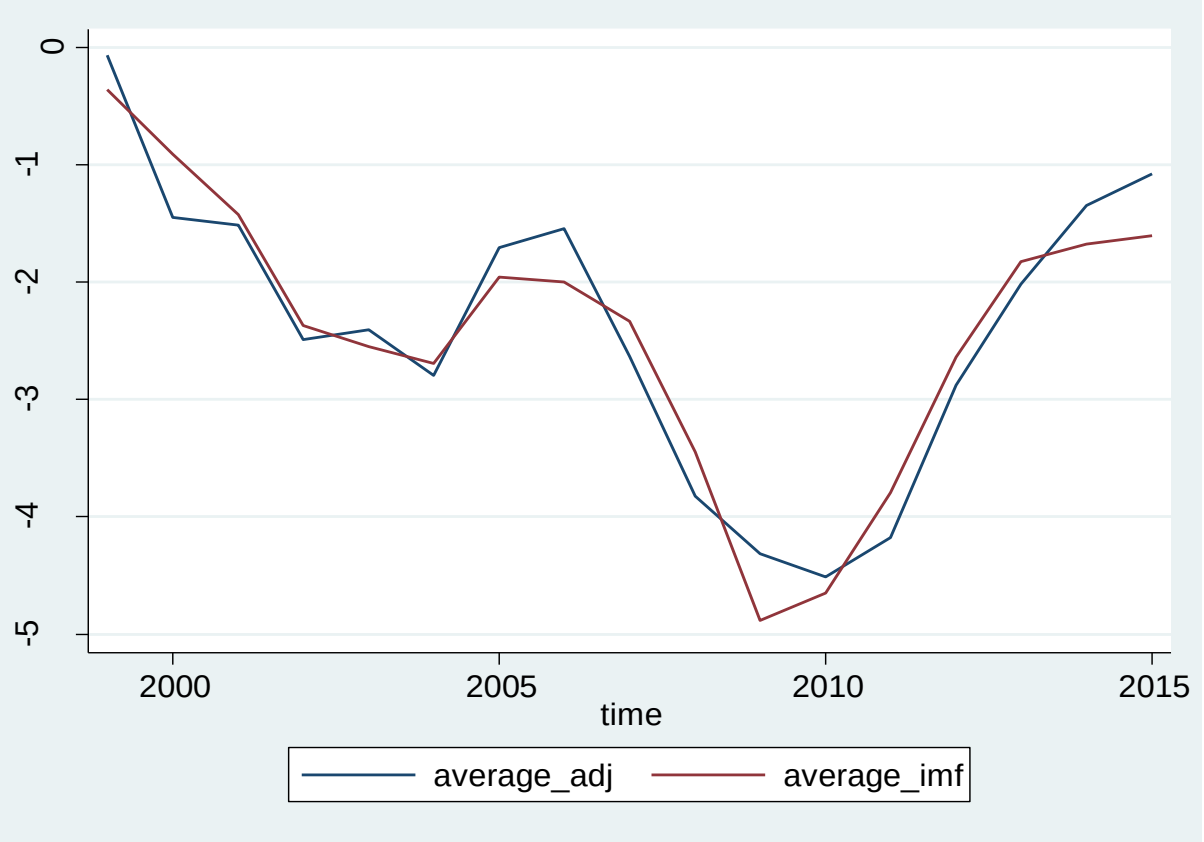


Figure 2.5. Average Adjusted structural balance (blue) and Average IMF CAPB (red)

CHAPTER 3: A new action-based dataset of fiscal policy decisions (2006-2015)

1. Introduction

This paper extends the work of Guajardo et al. (2011) by constructing a new database of fiscal measures taken by the governments of 20 OECD economies during 2006-2015.

The existing literature usually identifies fiscal policy consolidation using a statistical concept such as the increase in the cyclically-adjusted primary budget balance (CAPB). However, using the CAPB to estimate the macroeconomic effects of policy action is problematic. The problem is that the fiscal response is difficult to measure. This is because both revenue and expenditure statistics fluctuate significantly with the business cycle.

First, cyclical adjustment methods are subject to measurement errors that are likely to be correlated with economic developments and mainly arise because of revenue fluctuations as shown in Morris & Schuknecht (2011). While CAPB measures capture only the fluctuations of taxes on income and taxes on consumption out of income, asset price booms usually lead to improvements in the CAPB from the increase in taxes collected on changes in wealth, i.e., capital gains. Also, due to the increased domestic demand, the taxes collected on consumption out of increased wealth and taxes on the transfer of wealth are also likely to be increased. Therefore, it is important to adjust it for temporary factors, such as housing, stock, and asset prices, which may affect fiscal balances, concealing the underlying structural fiscal position.

Another complication for the analysis of fiscal policy using CAPB arises due to a large cross-country difference in the size of automatic stabilizers. As the IMF has noted, differences in the sizes of automatic stabilisers across countries mean that "in order to compare across countries the role fiscal policy is playing in supporting economic activity, it is better to focus not just on its discretionary component." On the other hand, the discretionary government response is likely to depend partly on the size of the automatic stabilizers. In this paper, I still endeavour, where possible, to disentangle the fiscal effort into two clear categories of automatic stabilization and discretionary stimulus.

Additionally, calculations of cyclically adjusted fiscal balances depend on estimates of potential output. After a major shock such as the global financial crisis, it becomes difficult to identify the potential GDP. As a result, after the recent financial crisis, statistical bureaus frequently revised a-posteriori the levels of trend output and, therefore, the structural balance position.

All this means that changes in the CAPB as conventionally calculated are potentially correlated with the economic cycle (which may be irregular) and do not necessarily reflect policy decisions. These shortcomings complicate the estimation of the macroeconomic effects of policy decisions.

In this paper, fiscal action is identified using a historical approach similar to that of Ramey and Shapiro (1998), Ramey (2011), Romer and Romer (2010), and Devries, Guajardo, Leigh,

and Pescatori (2011). In particular, I examine policymakers' intentions and structural actions described in relevant policy documents. The historical sources I examine include Budget Reports, Budget Speeches, Stability and Convergence Programmes submitted by the authorities to the European Commission, IMF Article IV consultation reports and OECD Economic Surveys. In some cases, I examine country-specific sources, such as the Congressional Budget Office (CBO) reports in the United States.

The data are presented at an annual frequency. The countries included in our sample are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

I construct a categorical variable describing a country's fiscal stance in a particular year, ranging from 3 (which means the tightest form of austerity) to -3 (which means the injection of a large fiscal stimulus). The thresholds used to classify the fiscal stance are arbitrary in nature, but they plausibly discriminate between categories and should give us an objective view of a government's fiscal stance. A discretionary fiscal effort contrasted against a no-policy scenario between -0.2 and +0.2% of GDP receives a 0 score; fiscal effort in either direction of a magnitude more than 0.2% of GDP but less than 1% of GDP receives 1; more than 1% but less than 2% of GDP - score 2; and if more than 2% of GDP - score 3.

The resulting variable represents the fiscal stance of a government at a particular year. For, example if the government of a country decided to implement a discretionary stimulus package of a size equal to 1.5 % both in 2009 and 2010, then the fiscal score is -2 in both years.

The results of the analysis are assembled in the appendix.

2. Country-by-country summary of our findings

In this section, I provide a comprehensive overview of the fiscal stance during 2006-2015 of the countries in the sample with a sufficient number of quotations and citations from the historical record so that the reader can see the evidence behind the conclusions regarding the motivation and budgetary impact of fiscal measures.

Austria

Austria 2006: -2

After the trough in the international business cycle in the year 2001, the Austrian economy recovered faster than the average of the Eurozone countries. The November 2005 Stability Programme set out a three-pronged strategy for policy until 2008, highlighting the importance of balancing the budget over the economic cycle, lowering the tax burden to less than 40% of GDP by 2010 and raising potential growth by fostering investment in R&D.

> In 2005 and 2006, the Austrian government temporarily accepts higher deficits as a result of the tax reform in order to strengthen the purchasing power of private households and to provide a more favourable environment for business activity in a sustained manner. The tax burden will fall to below 41% of GDP in the year 2006 already. (2005-2006 Stability Programme, p.11).

Spending reductions and measures to raise additional revenue did not fully offset the impact of the tax reduction on the general government balance. The decomposition of the effects of the 2004/2005 tax reform as well as of the two Stimulus Packages and the Growth and Competitiveness Package is provided in the 2005-2006 Stability Programme. The cumulative effect of these measures on balance amounted to -2.1% of GDP in 2006. Therefore, the fiscal stance score of Austria for 2006 is -2.

Austria 2007: -1

In the authorities' view, despite modest economic growth and some measures that were still putting pressure on the budget balance, the path of public finances remained sustainable. As mentioned in the 2006-2007 Stability Programme (p.25):

> The national debt ratio declined from 66.0% of GDP in 2001 to 62.2% of GDP in 2006, due to slowdowns in expenditure dynamics in major areas of the public budget. In 2008 the national debt ratio is to decline to below the reference value of the Maastricht treaty of 60% of GDP.

As mentioned in the Article IV 2006 Consultation (Preliminary Conclusions),

> A "no policies" baseline scenario has been agreed upon by the two parties as the basis for budgetary projections in the context of the coalition discussions. This scenario shows an increase in the deficit to about 1½ percent of GDP in 2007 and 2008.

From 2007 on, the temporary effects of the abovementioned reforms amounting to 0.4 ppts of GDP ceased to exist. However, the impact of them on the budget balance in 2007 still amounted to about -1.7% of GDP. The authorities and IMF realized the need to return to a balance by 2008. This, as stated in the 2006 Article IV report, required additional structural adjustment of about 0.5% for both 2007 and 2008, coming mainly from the reduction in expenditure.

Since the structural deficit contracted by about 1 ppt since 2006, the fiscal score of Austria for 2007 is -1.

Austria 2008: 0

The government confirmed its objective of a structurally balanced budget by 2010. However, IMF staff was sceptical about the possibility of meeting it. The expenditure measures did not offset tax cuts in recent years. According to the 2008 Article IV report:

> The general government fiscal deficit narrowed significantly in 2007, but the structural deficit remains high." And since the additional tax cuts were planned to be implemented by 2010, IMF staff estimated that achieving structural balance would

> require a consolidation of about 2 percent of GDP. However, the authorities were more optimistic about economic growth and the strength of tax revenues. (p.10)
>
> In September 2008, the authorities passed a stimulus package that envisaged a fiscal impulse of 0.3 percent of GDP in 2008 and additional stimulus in 2009-10. For 2008, the package increased family and pension benefits and reduced unemployment insurance contributions. More than offsetting this, however, were earnings-related tax receipts that increased on the back of strong labor market performance. (2009 Article IV Report, p.17)

According to the 2008 Article IV report, the fiscal stance was broadly neutral in 2008 despite some stimulus measures. Therefore, in the classification, it is given the score 0.

Austria 2009-2010: -2 and -1

According to the 2009 Stability Programme:

> The public debt ratio has fallen continuously over the last years. This is the result of both a dynamic economic development and decelerating dynamics of public expenditures. Due to the banking rescue package that has become necessary in the course of the financial and economic crises, public debt was again lifted to 62.5% in 2008. A further increase to slightly below 80% is expected until 2013. (pp.24-25)
>
> The 2009/10 budget includes a stimulus package of 1.5 percent of GDP in 2009 and an additional 0.4 percent of GDP in 2010. In contrast to other packages, the Austrian package consists mostly of personal income tax (PIT) cuts. Since only the top half of income earners is subject to PIT, the multipliers of the package will be relatively low. Public investment, which has the highest multipliers if rapidly implemented, represents less than 5 percent of the package. (2009 Article IV Report, p.17)

Given the government's structural actions and the size of the recovery support package, the fiscal stance was scored at -2 in 2009 and -1 in 2010.

Austria 2011: 1

In connection with the 2011 federal budget, the authorities realized that to achieve a long-run sustainable fiscal position, consolidation plans needed to be implemented. On the revenue side, these included a bank levy and higher mineral oil taxes. On the expenditure side, expenditure reductions were spread across several categories and were complemented by simultaneous increases in priority areas, such as education and R&D. Overall, the consolidation efforts were around 0.4 percent in 2011, which is the reason for the fiscal score of 1.

According to the 2011 Article IV Report, the IMF staff urged stronger consolidation measures of at least 0.5% of GDP annually. The authorities, however, viewed the existing consolidation plans as adequate and stressed that further efforts were not politically feasible in the short-term.

Austria 2012: 1

> In October 2010, a comprehensive package of measures paved the way for the implementation of the recommendations ("Loipersdorf-package"). The Federal Government approved measures totalling 13.6 bn € for the period 2011 to 2014. The consolidation path provided for a gradual reduction of the deficit from 4.6% of GDP in 2010 to 3.9% of GDP in 2011 down to 2.9% of GDP in 2013. (2012 Stability Programme, pp.11-12)
>
> Consolidation is to the larger extent implemented on the expenditure side: At the general government level (excluding ÖVAG), two thirds of the measures are on the expenditure side and one third is accounted for by tax increases (these calculations do not include the foreseen revenue effects originating from measures in the areas of pension and social insurance). (p.17)

In addition,

> On 7 December 2011, the Austrian Parliament adopted a debt brake inspired by the German model. The debt brake specifies that the Austrian federal budget has to be structurally balanced by 2017. The target of the debt brake is twofold: It prevents chronic structural deficits and permanently establishes a counter-cyclical budgetary policy compatible with the business cycle. During recessions, the debt brake allows for short-term deficits but requires their immediate reduction or even surpluses in boom phases. (2012 Stability Programme, p.15)

Overall, the government aimed to reduce the structural deficit and put the debt ratio on a strictly downward path from 2013 onwards. However, the pace of consolidation did not exceed 1 percent of GDP, and the fiscal stance score for 2012 is 1.

Austria 2013-2014: both 0

Overall, in 2013 the government pursued the strategy described in the second consolidation programme adopted in 2012, which seeks for an appropriate balance between debt sustainability and growth considerations.

According to the 2013 OECD Economic Surveys (p.18):

> On the spending side, the consolidation programme envisages savings by bringing the actual retirement age closer to the statutory one, including by imposing stricter eligibility criteria on several subsidised early retirement paths, in particular disability pensions. To cut costs in the public administration, pay and hiring freezes, better management of federal real estate holdings and the merger of small district courts are planned. Savings on the lower government level are envisaged from better targeting subsidies and a health care reform […]. Along with these saving measures, additional funds for universities, full day care schools, research and development and thermal insulation totalling EUR 6 billion over the period 2012-16 have been made available to stimulate growth. On the revenue side, the main measures include changes in the capital gains tax on real estate, closing tax loopholes in the VAT, a tax hike for high-income earners, and a tax repatriation agreement with Switzerland.

According to IMF 2014 Article IV report:

> The Austrian government pursues the goal to achieve a structurally balanced budget by 2016. (p.2)
>
> Austria's structural deficit is not high, but as this deficit excludes a number of expenditures, including for bank support, debt dynamics are not as favorable. On current plans, the structural deficit will decline from 1 percent of GDP in 2013 to ½ percent of GDP from 2016 onwards. (p.16)

Overall, the major reforms and consolidation plans were implemented during 2011 -2012. From 2013, the fiscal stance can be described with score 0 in the classification as broadly neutral with the consolidation continuing at a modest pace, mainly ensuring the downward trajectory of the debt ratio.

Austria 2015: 0

Overall, the trend of neutral fiscal policy continued in 2015. Importantly, although the debt ratio increased dramatically in 2015, it was due to one-off measures which are irrelevant for the structural balance calculation. Therefore, the fiscal stance score remained 0.

The main points were explained in the 2015 Stability Programme (pp.23-24),

> For the calculation of the structural balance, bank support measures of 1.7 bn € are considered one-off and are subtracted. Their main element is a Federal State guarantee for a subordinate bond of the formerly Hypo-Alpe-Adria (1 bn €) that will become due in 2015.
>
> The general government debt ratio was expected to rise to 86.8% of GDP. The reason for this increase is the planned merger of a part of the liabilities of Kommunal-Kredit Austria AG with KA-Finanz AG which, in statistical terms, is attributed to the government sector because of this year's restructuring of Kommunal-Kredit Austria AG. One part of Kommunal-Kredit Austria AG was sold to a private group of investors and the other part was merged into KA-Finanz. Since KA-Finanz is considered part of the public sector in national account terms, this measure will raise public liabilities (i.e. the public debt level) by 6.3 bn €.

<u>United States</u>

United States 2006-2007: both 1

According to January 2006 Congressional Budget Office report (pp.13-14):

> The Congressional Budget Office (CBO) projects that under current laws and policies, the federal budget will report a deficit of $337 billion in 2006 […]. That estimate is somewhat higher than the $318 billion shortfall recorded in 2005 but about the same in comparison to the size of the nation's economy. At 2.6 percent of gross domestic product (GDP), this year's deficit would be slightly larger than the 2.3 percent average recorded since 1965.

> Over the longer term, the aging of the U.S. population combined with rapidly rising health care costs will put significant strains on the federal budget, which begin to be evident within the projection period. A substantial reduction in the growth of spending and perhaps a sizable increase in taxes as a share of the economy will be necessary for fiscal stability to be at all likely in the coming decades.

From January 2007 Congressional Budget Report (p.11):

> If current laws and policies remained the same, the budget deficit would equal roughly 1 percent of gross domestic product (GDP) each fiscal year from 2007 to 2010, the Congressional Budget Office (CBO) projects. Those deficits would be smaller than last year's budgetary shortfall, which equaled 1.9 percent of GDP […]. Under the assumptions that govern CBO's baseline projections, the budget would essentially be balanced in 2011 and then would show surpluses of about 1 percent of GDP each year through 2017 (the end of the current 10-year projection period).

According to Budget tables, the government projects to reduce outlays from 20.8% GDP to 20.1% (the effect of this decrease is coming from a projection of GDP) with the receipts growing from 17.5 to 17.6 percent which mean a reduction of the deficit by 0.6% from 3.2 to 2.6 percent. Department of Defence and Homeland Security expenses grow, while it was planned to decrease (relative to GDP) the outlays in other operations of Government.

Summing up, in 2006-2007 the authorities expect further economic expansion. They expect growing expenses on Medicare due to the aging population, but they prepare substantial reductions of other expenditures and perhaps tax increases. Therefore, the government takes a conservative view on public finances, planning to run a balanced budget in the long-term. The fiscal score is therefore 1.

United States 2008: -1

In its January 2008 statement the CBO projected just a minor increase in a deficit in 2008 compared to 2007, and the authorities did not expect the slowdown in economic growth to be large enough to register a recession. In the September issue, the forecasts made by the CBO become more realistic although they did not capture the full extent of the deterioration in public finances:

> CBO expects the deficit to rise from 1.2 percent of GDP in 2007 to 2.9 percent this year […]. The significant expansion in the deficit is the result of a substantial increase in spending and a halt in the growth of tax revenues. In 2008, CBO estimates, federal spending will be 8.3 percent higher than in 2007; at the same time, total revenues will probably be less than they were in 2007.
>
> Outlays will rise by $226 billion this year, to nearly $3.0 trillion, CBO estimates, as a result of rapid growth in both discretionary and mandatory spending. In total, mandatory spending—driven by increases in many large programs, outlays resulting from the stimulus legislation, and a jump in expenditures to cover the insured deposits of insolvent financial institutions—will increase by $135 billion from the amount in 2007, a 9.3 percent rise. Outlays for discretionary programs—whose funding is set

> anew each year through appropriation acts—are anticipated to rise by $85 billion, or 8.1 percent, this year; the bulk of that increase stems from defense spending. The government's net interest costs will increase by $7 billion, or 2.9 percent, CBO estimates. (CBO report September 2008, p.9)

Overall, in 2008, although the authorities realize the need to stimulate the sluggish economy, much of the deficit is still driven by significant cyclical market volatility. Therefore, the fiscal score turns mildly expansionary at -1.

United States 2009: -3

From January 2009 CBO report (pp.1-2):

> The sharp downturn in housing markets across the country, which undermined the solvency of major financial institutions and severely disrupted the functioning of financial markets, has led the United States into a recession that will probably be the longest and the deepest since World War II. The Congressional Budget Office (CBO) anticipates that the recession - which began about a year ago - will last well into 2009.
>
> CBO projects that the deficit this year will total $1.2 trillion, or 8.3 percent of GDP. Enactment of an economic stimulus package would add to that deficit. In CBO's baseline, the deficit for 2010 falls to 4.9 percent of GDP, still high by historical standards. CBO expects federal revenues to decline by $166 billion, or 6.6 percent, from the amount in 2008.
>
> According to CBO's estimates, outlays this year will include more than $180 billion to reflect the present value of the net cost of transactions under the Troubled Asset Relief Program (TARP), which was created in the fall of 2008. The TARP has the authority to enter into agreements to purchase assets totaling up to $700 billion outstanding at any one time, but the net cost over time will be much less than that amount.
>
> The deficit for 2009 also incorporates CBO's estimate of the cost to the federal government of the recent takeover of Fannie Mae and Freddie Mac. They are currently under the direct control of the federal government, CBO has concluded that their operations should be reflected in the federal budget. Recognizing that cost in 2009 adds about $240 billion (in discounted present-value terms) to the deficit this year.

From August 2009 CBO report (pp.9-10):

> The Congressional Budget Office (CBO) estimates that the federal budget deficit for 2009 will total $1.6 trillion, which, at 11.2 percent of gross domestic product (GDP), will be the highest since World War II. That deficit figure results from a combination of weak revenues and elevated spending associated with the economic downturn and financial turmoil. The deficit has been boosted by various federal policies implemented in response, including the stimulus legislation and aid for the financial, housing, and automotive sectors.

> Although various indicators suggest that the recession may have ended or is likely to end within the next few months, CBO's economic forecast anticipates a relatively slow and tentative recovery. The deficit would shrink but remain above $500 billion per year, or more than 3 percent of GDP, throughout the 2010–2019 period. That debt, which was as low as 33 percent of GDP in 2001, would reach an estimated 54 percent of GDP this year and grow to 68 percent of GDP by 2019.
>
> The dramatic expansion of the deficit in 2009 (up from 3.2 percent of GDP in 2008) results from a projected rise in outlays of 24 percent (the largest percentage increase since 1952) and a drop in revenues of 17 percent from last year's levels (the largest percentage drop since 1932). Those changes have largely been the result of the severe economic downturn and the fiscal impact of federal policies enact ed in response.
>
> Outlays will rise by about $700 billion this year, in CBO's estimation. Much of that increase results from legislation enacted in calendar year 2008 in response to turmoil in the housing and financial markets—in particular, $133 billion for the Troubled Asset Relief Program (TARP) and $291 billion for the estimated costs of placing Fannie Mae and Freddie Mac into conservatorship. CBO expects that total spending in 2009 from funding provided by the American Recovery and Reinvestment Act (ARRA, Public Law 111-5) will reach about $115 billion.

Summing up, the authorities understand the scope of the event, even exaggerating a bit its effect on future revenues. The authorities open up a discretionary fiscal stimulus, including TARP, salvation of Fannie Mae Freddie Mac and increase of expenditure under American Recovery and Reinvestment Act (ARRA, Public Law 111-5). This explains the fiscal score of -3 in 2009.

United States 2010: -3

From January 2010 CBO report (p.11):

> The deep recession that began two years ago appears to have ended in mid-2009. Economic activity picked up during the second half of last year, with inflation-adjusted GDP and industrial production both showing gains. Still, GDP remains roughly 6½ percent below CBO's estimate of the output that could be produced if all labor and capital were fully employed. Economic growth in the next few years will probably be muted in the aftermath of the financial and economic turmoil.

From August 2010 CBO report (p.9):

> The Congressional Budget Office (CBO) estimates that the federal budget deficit for 2010 will exceed $1.3 trillion—$71 billion below last year's total and $27 billion lower than the amount that CBO projected in March 2010, when it issued its previous estimate. Relative to the size of the economy, this year's deficit is expected to be the second largest shortfall in the past 65 years: At 9.1 percent of gross domestic product (GDP), it is exceeded only by last year's deficit of 9.9 percent of GDP. As was the case last year, this year's deficit is attributable in large part to a combination of weak

> revenues and elevated spending associated with the economic downturn and the policies implemented in response to it.

Overall, the fiscal policy still remains accommodative in 2010 without any hint about wrapping up programmes. Actual deficits continue to exceed all the projections, which is mostly due to policies to combat the effect of the financial storm. The fiscal score, hence, remains unchanged at -3.

United States 2011: -2

According to January 2011 CBO report (pp.11-14):

> The recovery now under way might be expected to lessen the budget imbalance in 2011 by increasing tax revenues and decreasing spending for certain income-support programs, such as unemployment compensation. However, revenue growth will be restrained by the slow and tentative pace of the recovery and by the 2010 tax act. The United States faces daunting economic and budgetary challenges. The economy has struggled to recover from the recent recession, which was triggered by a large decline in house prices and a financial crisis.
>
> Spending, for the most part, has been growing faster than revenues. Programs related to the federal government's response to the problems in the housing and financial markets are an exception; outlays recorded for the Troubled Asset Relief Program (TARP), for example, will decrease by $176 billion from 2009 to 2011.
>
> According to CBO's projections, mandatory spending excluding outlays for the TARP will increase by $191 billion (or 10 percent) between 2009 and 2011. Significant growth in many areas—in particular, for Social Security, Medicare, and Medicaid—is expected to be offset only partially by reductions in outlays for other programs, primarily for Fannie Mae, Freddie Mac, and deposit insurance. Discretionary spending will increase by an estimated $137 billion over the two-year period; about one third of that increase stems from funding provided by the American Recovery and Reinvestment Act of 2009 (ARRA). In addition, outlays for net interest will rise by an estimated $38 billion from 2009 to 2011, mostly because of substantial increases in borrowing.
>
> For 2011, the Congressional Budget Office (CBO) projects that if current laws remain unchanged, the federal budget will show a deficit of close to $1.5 trillion, or 9.8 percent of GDP […]. The deficits in CBO's baseline projections drop markedly over the next few years as a share of output and average 3.1 percent of GDP from 2014 to 2021.

Therefore, the rhetoric of CBO clearly indicates that the expansion of the deficit has been huge in the previous 2-3 years and underscores the need to gradually wrap up the stimulus programmes over the coming decade. In 2011, Budget Control Act was adopted, which set caps on future discretionary spending and created a process for adopting additional deficit reduction measures. The policy in 2011 still remained accommodative with some signs of the

restraint due to a drop in the outlays on TARP and bailouts. This explains the fiscal score of -2.

United States 2012: -1

August 2011 CBO report (p.10) specifies the following policies to be implemented:

> The two-year extension of provisions designed to limit the reach of the alternative minimum tax, extensions of emergency unemployment compensation, and the one-year reduction in the payroll tax all expire at the end of 2011; Sharp reductions in Medicare's payment rates for physicians' services take effect at the end of 2011; Funding for discretionary spending declines over time in real terms, in accordance with the caps established under the Budget Control Act.

From January 2012 CBO report (pp.11-12):

> As specified in law, and to provide a benchmark against which potential policy changes can be measured, CBO constructs its baseline estimates of federal revenues and spending under the assumption that current laws generally remain unchanged. On that basis, the federal budget will show a deficit of nearly $1.1 trillion in fiscal year 2012. Measured as a share of gross domestic product (GDP), that shortfall will be 7.0 percent, which is nearly 2 percentage points below the deficit recorded last year but still higher than any deficit between 1947 and 2008.
>
> Projected spending averages 21.9 percent of GDP over the 2013–2022 period, a percentage that is less than the 23.2 percent CBO estimates for 2012 but that is still elevated by historical standards. In the baseline, discretionary spending is projected to decline to 5.6 percent of GDP in 2022—the lowest level in the past 50 years. Those constraining factors will be partially offset by increases in spending for mandatory programs, particularly Social Security, Medicare, Medicaid, and other federal health care programs: Mandatory spending is projected to climb from 13.3 percent of GDP in 2013 to 14.3 percent in 2022.

The recovery has started and the government starts to remove the stimulus from the economy. In 2012 fiscal policy remained accommodative and serious austerity measures are still to come in 2013. Therefore, the fiscal score in 2012 is -1.

United States 2013: 2

From August 2011 CBO report (p.10):

> Certain provisions of the 2010 tax act, including extensions of lower rates and expanded credits and deductions originally enacted in the Economic Growth and Tax Relief Reconciliation Act of 2001, the Jobs and Growth Tax Relief Reconciliation Act of 2003, and the American Recovery and Reinvestment Act (ARRA), expire at the end of 2012.

Additionally, according to August 2012 CBO report (p.3):

> Sharp reductions in Medicare's payment rates for physicians' services are scheduled to take effect. Automatic enforcement procedures established by the Budget Control Act of 2011 (…) to restrain discretionary and mandatory spending are set to go into effect. Extensions of emergency unemployment benefits and a reduction of 2 percentage points in the payroll tax for Social Security are scheduled to expire.

From May 2013 CBO report (p.1):

> If the current laws that govern federal taxes and spending do not change, the budget deficit will shrink this year to $642 billion, the Congressional Budget Office (CBO) estimates, the smallest shortfall since 2008. Relative to the size of the economy, the deficit this year—at 4.0 percent of gross domestic product (GDP)—will be less than half as large as the shortfall in 2009, which was 10.1 percent of GDP. Because revenues, under current law, are projected to rise more rapidly than spending in the next two years, deficits in CBO's baseline projections continue to shrink, falling to 2.1 percent of GDP by 2015.

Summing up, the fiscal stance becomes tightening with most of the government stimulus programmes finally wrapped up in the course of 2013. The deficit in 2013 shrunk substantially, which is why the fiscal stance score is 2.

United States 2014: 2

From August 2014 CBO report (pp.1-2):

> The federal budget deficit for fiscal year 2014 will amount to $506 billion, CBO estimates, roughly $170 billion lower than the shortfall recorded in 2013. At 2.9 percent of gross domestic product (GDP), this year's deficit will be much smaller than those of recent years. Spending is expected to rise by about 2 percent this year, to $3.5 trillion. Outlays for mandatory programs are projected to rise by about 4 percent. That increase reflects growth in some of the largest programs— including a 15 percent increase in spending for Medicaid and a roughly 5 percent increase in spending for Social Security. Discretionary spending, which is controlled by annual appropriation acts, is anticipated to be 3 percent less in 2014 than it was in 2013. Nondefense discretionary spending is expected to be about the same this year as it was last year, but defense spending is likely to drop by about 5 percent. Revenues are expected to increase by about 8 percent this year from last year's amounts, to $3.0 trillion. Revenues from all major sources will rise this year, including individual income taxes (by an estimated 6 percent); payroll taxes (by 8 percent); and corporate income taxes (by 15 percent). Increases in wages and salaries and changes in laws—such as those affecting payroll tax rates and income tax deductions for investments in business equipment—largely account for the higher tax receipts.

Overall, nothing unexpected happened in 2014, and the trend of reduction in the structural deficit (mainly due to rising revenues and outlays growing much more slowly) continued at a pace of at least 1 ppt per year, which is why the fiscal score remains unchanged.

United States 2015: 1

From January 2015 CBO report (p.1):

> The federal budget deficit, which has fallen sharply during the past few years, is projected to hold steady relative to the size of the economy through 2018. Beyond that point, however, the gap between spending and revenues is projected to grow, further increasing federal debt relative to the size of the economy.
>
> CBO estimates that the deficit for this fiscal year will amount to $468 billion, slightly less than the deficit in 2014 […]. At 2.6 percent of GDP, this year's deficit is projected to be the smallest relative to the nation's output since 2007 but close to the 2.7 percent that deficits have averaged over the past 50 years.

In 2015 the deficit reduction continued. This was due to essentially steady outlays and higher revenues due to strong economic recovery and expiration of some tax cut provisions. The fiscal score is 1 since the pace of consolidation was slightly smaller. After 2017 the slack in the economy is expected to dissipate, in particular in labour markets, which may cause the deficits to expand.

United Kingdom

United Kingdom 2006: 1

As mentioned in the 2006 Article IV report (p.18):

> A substantial fiscal expansion in 2001–04 led to a sharp deterioration in the fiscal balance and rising net public debt […]. During this period, the government undertook a significant expansion in spending to increase public services.

In FY 2005/06, the fiscal position improved primarily due to windfall energy-price-related revenues and higher revenues from the booming financial sector. Fiscal adjustment in FY 2005/2006 was in line with the IMF's views on the need to narrow the fiscal deficit and stabilize net public debt. The cyclically-adjusted overall balance relative to GDP improved by ½ percentage point. The authorities planned further adjustment over the medium term so as to return the current balance to surplus, relying primarily on spending restraint to do so. (2006 Article IV report). Given the moderately tightening stance, the fiscal score in 2006 is 1.

United Kingdom 2007: 1

> Despite output having been generally below trend since 2001, net debt remains below 39 per cent of GDP and starts to decline by the end of the projection period, reaching 38.6 per cent of GDP in 2012-13. The current budget strengthens through the projection period, returning to surplus in 2008-09 and showing a surplus of 0.8 per cent of GDP in 2011-12. (2007 Convergence Programme, p.4)

According to the 2006 Budget Report, there was a significant tightening in the fiscal stance between Budget 2005 and the 2005 Pre-Budget Report (overall impact of 0.4% GDP) due to a combination of discretionary policy action and non-discretionary factors. The 2006 Budget locks in this tighter fiscal stance with a modest discretionary tightening in the medium term. Cyclically-adjusted net borrowing is estimated to have fallen by around 0.75 per cent of GDP

to 2.4 per cent, while the cyclically-adjusted deficit on the current budget fell by 1 per cent of GDP to around 0.25 per cent of GDP. Therefore, the fiscal stance score remains at 1 in 2007.

United Kingdom 2008: 1

> Non-discretionary factors play a major role, as the Government accommodates the changes to tax receipts and public spending that result from the impact of the continued disruption in financial markets. Discretionary policy measures in the 2007 Pre-Budget Report and the 2008 Budget are neutral in the short term followed by a modest tightening, partially offsetting the stimulus coming from non-discretionary factors, underpinning sustainable public finances as the economy moves back towards trend. (Budget 2008, p.32)

The deterioration in the public deficit was mainly cyclical. The structural policy stance remained moderately tightening in 2008. Therefore the fiscal score remained 1.

United Kingdom 2009-2010: -2 and -3

The stimulus package was one of the largest used by developed countries, with its size comparable to that of the United States. The discretionary component of the stimulus in 2009 amounted to about 1% of GDP including a temporary reduction in the rate of VAT to 15 per cent and the bringing forward of £3 billion of capital spending. Additionally, the automatic stabilizers, the size of which was one of the largest amongst OECD countries, were allowed to operate in full.

> The fiscal stimulus is complemented by the full operation of the automatic stabilisers and targeted support for those most affected by the downturn. Together, through these channels, fiscal support totals 5 per cent of GDP in 2009-10 (Pre-Budget Report 2009, p.31)

As stated in the 2010 Budget,

> The global economy is in the early stages of recovery after the most severe and synchronised contraction in 60 years. However, the recovery remains modest. The Government took decisive action to support the economy during the financial crisis and its aftermath. As the UK emerges from recession, it remains vital to maintain some targeted assistance to support the recovery through 2010. (p.1)
>
> Both the automatic stabilisers and the fiscal stance acted to provide a considerable degree of support to growth in 2008-09 and 2009-10, during the economic downturn, with a cumulative impact of around 4 per cent and 5 per cent respectively in those years. In 2010-11, with planned increases in Government spending of £11 billion in real terms, borrowing of 11.1 per cent of GDP continues to support the level of economic activity. From 2011-12, with the economy growing at above trend rates and able to support fiscal consolidation, tightening of policy and the automatic stabilisers will work together to deliver a reduction in borrowing. (p.32)

Due to a large discretionary package and overall support to the economy caused by the operation of automatic stabilizers, the fiscal stance was given a score of -2 in 2009 and -3 in

2010. For the future, the Government introduced a Fiscal Responsibility Bill to Parliament. The Bill required the Government to set out at all times a statutory fiscal plan for delivering sound public finances, and placed a binding duty on the Government to meet that plan.

United Kingdom 2011: 2

As set out in the 2011 Budget, the prevailing historically high level of public borrowing risked undermining fairness, growth and economic stability in the UK. The June 2010 Budget set out comprehensive policies to bring the public finances back under control. As set out in Table 1.1 of the 2011 Budget, the Government plans a total consolidation of £126 billion a year by 2015-16, consisting of total reductions in spending of £95 billion and a net increase in taxes of £30 billion. Under the plans that this Government inherited, £14 billion of spending cuts and £14 billion tax increases were planned in 2011-12 (in total 1.6 % of GDP). The total discretionary consolidation decided by the current government, however, was planned to have a significantly larger scale, which is £61 billion (3.7 % of GDP). Therefore, the fiscal score of the United Kingdom in 2011 is 2.

United Kingdom 2012: 2

> At Autumn Statement 2011, the Government set out a clear and credible response to the economic and fiscal deterioration in the OBR's November 2011 forecast, meeting its fiscal targets and ensuring that the public finances are returned to a sustainable path. (Budget 2012, p.17)

Overall, the consolidation followed the schedule set out in the 2011 Budget, and the fiscal stance score remained 2. Actual total discretionary consolidation was £59 billion taken including 2011-2012 and 2012-13, which is significantly larger than the consolidation planned by the previous government (£39 billion). Explaining the increase in consolidation plans, the authorities in the 2012 Budget say, "Fiscal consolidation is critical for the UK to maintain market confidence and minimise risks to economic stability and also to allow for more activist monetary policy".

United Kingdom 2013-2014: both 2

The 2013 Budget (p.19-20) sets out the following objectives:

> -A fiscally neutral Budget that reinforces the Government's commitment to deficit reduction, primarily through spending consolidation;
>
> - a reduction in Resource Departmental Expenditure Limits (RDEL) of £1.1 billion in 2013-14 and £1.2 billion in 2014-15, helping to support the housing package in the short term and contributing to the overall savings required from current spending in 2015-16;
>
> -an envelope for current spending in 2015-16 of £694.2 billion, enabling the Government to increase capital spending plans by £3 billion a year and ensuring consolidation is underpinned by clear, credible and specific medium-term plans for delivery; and

> -a sustained decline in the structural deficit as headwinds to growth ease, with cyclically-adjusted net borrowing falling by an annual average of around 1 per cent of GDP over the forecast period.

As a result of the plans set out in the 2013 Budget (p.27),

> Public spending is projected by the OBR to fall from 47.4 per cent of GDP in 2009-10 to 40.5 per cent of GDP by 2017-18, around the same level as 2004-05 and close to its long-run average. Public sector current receipts are projected to rise from around 36.2 per cent of GDP in 2009-10 to around 38.3 per cent of GDP by 2017-18.

Overall, by 2013-2014 fiscal year, the total discretionary consolidation amounted to £84 billion from 2011-2012, with 70% of measures on the expenditure side.

In 2014, the consolidation followed the abovementioned plan. Total discretionary consolidation since 2011-2012 now stood at 106 billion (about 7 percent of GDP, compared to £70 billion planned by the previous government). Hence, the fiscal score remained unchanged at 2 in both 2013 and 2014.

United Kingdom 2015: 2

From the 2015 Summer Budget (policy paper),

> Since 2010, the government has pursued a long-term economic plan that has halved the deficit as a share of GDP. For the first time since 2001-02, the national debt is falling in 2015-16, meeting the target set out in 2010. But the job is not yet done. At 4.9%, the deficit remains too high, and productivity remains too low. The government will continue to reduce the deficit by around 1.1% of GDP a year on average, the same pace as over the last Parliament. This fiscal path means that the deficit falls smoothly, and that debt falls as a share of GDP in every year of the Parliament. At the same time, the government will ensure that the UK spends 2% of GDP a year on defence for the rest of the decade, and that spending on the NHS in England increases by £10 billion per annum in real terms by 2020-21. As a result of this plan, a surplus will be achieved in 2019-20, and debt as a share of GDP in that year is forecast to be lower than expected in the March 2015 Budget. New fiscal rules will cement this fiscal path, and ensure that governments run surpluses in normal times.

Therefore, despite a substantial progress in improving the budget stance, the Government continued the consolidation at a similar pace to that in 2011-2014.

<u>Germany</u>

Germany 2006: 1

From the 2006 Stability Programme (p.6 and 9):

> One of the central tenets of fiscal policy in Germany is the sustainable consolidation of public budgets. (p.6)

> The increase in VAT must be seen within the overall context of reduced contribution rates to unemployment insurance and the huge progress made over recent years in reducing the burden from income and corporation tax. Shifting the burden from direct taxation and fiscal charges to indirect taxation is part of a strategic revenue structure which is more conducive to growth and more competitive. This remains the case even when the measures to broaden the tax base and the increase in the top rate of taxation for very-high income earners from 1 January 2007 are taken into account. (p.9)

From the 2006 Article IV report:

> Directors endorsed the authorities' policies to reduce the fiscal deficit below 3 percent of GDP by 2007, with some Directors calling for frontloading of adjustment and greater reliance on expenditure reduction. In the event, the deficit will be reduced to well below 3 percent in 2006. The structural adjustment of over 1 percent of GDP in 2006-07 is spread more evenly than was thought earlier, and has a significant expenditure component. (p.7)

> For 2006, the staff projects the deficit to decline to 2.4 percent of GDP from 3.2 percent in 2005, thereby observing the commitments under the excessive deficit procedure one year ahead of schedule. At the time of the mission (and prior to the update of the growth forecasts), the authorities cautiously projected the deficit to fall to 2.8 percent of GDP in 2006 and 2.3 percent in 2007, with a net contribution of ⅓ percent of GDP from the VAT hike and the partially offsetting cut in unemployment insurance contributions. (p.23)

Therefore, with consolidation efforts of approximately 0.5% of GDP, the fiscal stance of Germany in 2006 receives the score of 1.

Germany 2007: 1

From the 2007 Stability Programme (p.5):

> Germany's budget will already be balanced this year – for the first time since 1989. As from 2010, the level of debt will be below the 60% mark, so Germany will also meet the Maastricht Treaty's second important criterion. Both cyclical and structural factors are responsible for Germany's successful consolidation. The structural deficit was reduced by a total of approximately 2 percentage points in 2006 and 2007. This means that the general government budget will almost be balanced in structural terms, too, in 2007. The marked reduction in the structural deficit primarily reflects the consolidation measures adopted by the federal government and the continuation of the previously established restrictive expenditure line.

Germany remained on its consolidation path, with measures of the same magnitude as set out in 2006 throughout 2007 and, therefore, receives score 1.

Germany 2008: 1

From the 2008 Stability Programme:

> The reformed Stability and Growth Pact offers Member States, the Commission and the Council sufficient opportunity to deal with extraordinary circumstances, such as the ongoing financial market crisis, adequately. […] However, the German government believes that, in applying the Stability and Growth Pact, the structural consolidation of public budgets should be put at the heart of fiscal policy even in economically difficult times. (p.16)
>
> The continued consolidation in the current year 2008 is influenced to a large degree by the – on average – still quite favourable macroeconomic development. This consolidation has led to a noticeable easing of the pressure on public budgets. […]
>
> The general government budget balance will deteriorate to -½ % of GDP in the coming year. The main reason for the worsened general government budget balance in 2009 is the marked economic slowdown. (p.21)

Overall, it is evident that at the initial stage of the financial crisis, the German authorities do not see any need to support the economy with discretionary measures. In contrast, they remain on the consolidation trend described above, therefore, there is no reason to change the score describing the German fiscal stance.

Germany 2009: -2

In 2009, economic performance in Germany was down by 5% in real terms compared to the previous year. From Article IV 2008 Statement by Executive Director for Germany (p.4 of the Statement):

> The government has responded to the global economic slowdown speedily and decisively with an important fiscal stimulus package - which is already in effect - designed to secure growth and employment. The package adopted by the Cabinet on 7 October and 5 November 2008 predominantly contains growth-oriented measures that can be implemented in a timely manner. The objective is to create strong stimulus for private and public-sector investments, inter alia by investment funding to SMEs, tax incentives, targeted support to families and infrastructure investment. Furthermore, the Federal Constitutional Court has reinstated the commuting allowance (tax subsidy) which has an additional stimulus effect. The total volume of both the package and the commuting allowance in 2009 and 2010 will amount to approximately 40 bn euros (or over 1 ½ percent of GDP).

From the 2009 Stability Programme:

> The comprehensive measures undertaken to support the financial markets and the economy have made a marked contribution towards stabilising the economic situation and improving the long-term perspectives for growth in Germany. Nevertheless, the measures introduced to tackle the crisis together with the effects of the automatic stabilisers have left a deep mark on Germany's public budgets. (p.7)

In 2009, extremely unfavourable economic conditions translated into much larger fiscal deficits. In part this deficit expansion was cyclical, and in part it was a result of the fiscal

stimulus package that was adopted in late 2008. Since the stimulus measures exceeded 1% of GDP but were less than 2% of GDP, the fiscal stance of Germany in 2009 receives score -2.

Germany 2010: -1

From Article IV Consultation report 2010 (p.1 and 16):

> The authorities' policy measures—providing significant fiscal stimulus and letting automatic stabilizers work, mitigating systemic financial stress and supporting credit, and using labor market policies to smooth employment— were crucial to the resumption of growth. (p.1)
>
> During 2008 and 2009, the authorities legislated fiscal stimulus measures amounting to 1.5 percent of GDP for 2009 and 0.4 percent of GDP for 2010. (p.16)

From Executive Director for Germany Statement (p.3 of the Statement):

> From 2011 onwards, the focus will be on fiscal consolidation, as called for under the European Stability and Growth Pact as well as the new national constitutional rule (Schuldenbremse) to limit the government deficit. My authorities continue to pursue their medium-term goal of a close-to-balance government budget in structural terms.

In 2010, fiscal expansion still continues, but the measures are on a considerably smaller scale, which is the reason why the fiscal stance score is increased by 1 point to -1.

Germany 2011: 1

From the 2011 Stability Programme:

> The core economic and fiscal policy tasks are currently to phase out expansive fiscal policy measures and to maintain a course of consolidation that is sustainable and good for growth. By putting together a budget consolidation package (called the Zukunfspaket), the Federal Government laid the foundation in 2010 for a growth-oriented consolidation strategy that puts the budget rule into practice. (p.4)

The authorities have implemented a number of measures in the structural reform field including increasing spending on R&D, 2011 Tax Simplification Act (Steuervereinfachungsgesetz 2011) adopted by the Federal Government on 2 February 2011 serve to simplify and modernise the taxation process, Budget Support Act (Haushaltsbegleitgesetz 2011), aviation tax, Energy and Climate Fund set up in 2011. Also, the spendings on R&D were substantially increased.

Following the crisis-induced climb in expenditure, Germany has this year started to phase out discretionary stabilisation measures. Across all pending categories – apart from interest expenditure – there will be a reduction, in some cases substantial, in the average annual growth rates during the projection period. On an annual average for 2010 to 2015, expenditure will rise by only 1½% p.a. and, in comparison with nominal GDP growth averaging around 3% annually, will consequently be very low in proportion."

Overall, in 2011 Germany takes a consolidation route. This consolidation is, however, quite gradual and growth-friendly (IMF estimates it at 0.75 percentage points of GDP per year) and therefore receives score 1.

Germany 2012: 1

Overall, the economy is recovering at a faster rate than it was projected. According to the 2012 Stability Programme Update (p.8):

> Germany had already complied with the requirements of the corrective arm of the SGP in regard to net lending/borrowing in 2011 by significantly improving its general government budget balance by 3.3 percentage points to record a general government deficit of 1.0 % of GDP.

By December 2011, all stimulus programmes were planned to be wrapped up. From a sizeable stimulus, the authorities are moving towards a gradual consolidation and therefore the fiscal stance in 2012 receives score 1.

Germany 2013: 1

According to the 2013 Stability Programme, Germany achieved a structural surplus of +0.4 % of GDP and the surplus is expected to grow by 0.5 % of GDP thanks to continuing efforts in fiscal consolidation. The goal of the government is to reduce the debt ratio below 70%.

> Successful consolidation is not achieved through mechanical deficit cuts; instead, it is necessary to establish clear priorities and to leverage efficiency reserves that then lead to savings while simultaneously enhancing the conditions for economic growth. In 2013, the Federal Government will provide companies and private citizens with cost cuts totalling nearly €8 billion. In February, new legislation to reduce fiscal drag took effect that will reduce income tax burdens. Under this legislation, the basic personal allowance will be increased in two steps – to €8,130 in 2013 and €8,354 in 2014 – in order to bring it into line with the rise in minimum subsistence income. This will reduce the cost burden on taxpayers by €0.9 billion in 2013 and by an annual €2.6 billion from 2014 onwards. At the same time, the basic tax rate will be held constant at 14%. In addition, an increase in the loss carryback will provide companies with extra liquidity in periods of crisis. Furthermore, simplified tax rules on travel, meals and accommodation expenses will contribute to bureaucracy reduction. (2013 Stability Programme, pp.23-24)

Overall, Germany keeps on the same growth-friendly consolidation path. Structural reforms allow for structural measures that would help to boost revenues in future and comply with SGP requirements notwithstanding the problem of aging population**.** So the score remains unchanged at 1.

Germany 2014-2015: both 1

Overall, Germany continued growth-friendly consolidation and the federal government had been successful in balancing the federal budget without new borrowing in the year 2014,

doing so one year earlier than planned. Additional borrowing was also not required in 2015. Amongst particular structural reforms,

> The federal government has increased its financial commitments for the second phase of the 2020 Higher Education Pact, which goes until 2015, to some €7 billion. The federal government will substantially increase funding for federal transport infrastructure. Over the next four years, an additional €5 billion will be allocated for urgently needed investment in public transport infrastructure; these funds will primarily be used for maintenance. Of this total, €505 million will be made available in 2014. The Federation is supporting the creation of sustainable urban structures through programmes to promote urban development. (2014 Stability Programme Update, p.25)

So the score remains unchanged at 1.

Italy

Italy 2006-2007: both 1

From the 2006 Article IV report:

> The economy is enjoying a broad-based cyclical upswing. (p.1)
>
> Remarkably strong budget revenues translated into appreciable fiscal overperformance (net of one-offs) in 2006, despite substantial spending overruns. While the determinants of the revenue buoyancy — observed also in several other EU countries — remain to be fully explained, the increase is broad based and a substantial part seems structural. (p.8)
>
> Still, the general government deficit, net of two large one-off operations, is estimated by staff to have declined to 3.0 percent of GDP in 2006 (versus an original budget target of 3½ percent of GDP), implying an appreciable withdrawal of fiscal impulse. The headline deficit, however, is estimated to have risen to 5.0 percent of GDP. (p.44)

From the 2006 Stability Programme (p.14):

> The consolidation of public finances is consistent with the Ecofin Council Recommendation of July 2005, which called for a permanent adjustment in the cyclically-adjusted deficit, net of one-off measures, amounting to 1.6 percentage points of GDP over 2006-2007. Starting from 2008, the cyclically-adjusted budget should steadily decline by approximately 0.7 percentage points per year.

From the 2007 Stability Programme (p.18):

> With a view to meeting the medium-term target of a balanced budget by 2011, the Government is committed to speeding up structural adjustment as of 2009. The cyclically-adjusted deficit net of one-offs is expected to shrink at an average rate slightly below 0.8 per cent a year. In this way, the adjustment path is largely in line with what was recommended by the Ecofin Council of 2007, as the structural deficit will decrease by over 0.5 per cent a year. The cyclically-adjusted primary balance will

> therefore start growing again substantially, reaching 4.9 per cent of GDP in the final year, a rate which can ensure the long-term sustainability of public finances [...].

Despite some one-off measures which negatively affected the balance in 2006, Italy remained on the path for moderate reduction of the structural balance in 2006-2007 and therefore received a score of 1 in both years.

Italy 2008

From the 2008-2009 Stability Programme (p.13 and p.14):

> The growth rate of real GDP in 2008 is expected to be negative (-0.6 per cent) due to the effects of unfavourable trends in the international economy; this rate will thus reflect a contraction of almost 2 percentage points relative to 2007 (1.5 per cent). The real effects of the crisis are likely to have a negative impact on economic growth for all of 2009 (-2.0 per cent), while a gradual recovery should begin in 2010. (p.14)

> The anti-crisis decree adopted on 29 November 2008, immediately after the European Economic Recovery Plan, catalyzes a substantial €40 billion (auth. about 1.6% of GDP) of resources to fight the crisis: €6 billion to support households and businesses, €16 billion to finance infrastructure, including through project financing, €8 billion (estimated) for safety nets, and €10 billion (estimated) to finance enterprise through the issue of bank bonds against the risk of a credit crunch. (p.13)

Since the fiscal balance contraction was mainly cyclical and most measures under the anti-crisis decree were scheduled to take effect from 2009, the fiscal score in 2009 is 0, as broadly neutral.

Italy 2009: -1

From the 2009-2010 Stability Programme:

> In 2009, GDP experienced a substantial contraction (-4.8 per cent) which was added to that already seen in 2008 (-1.0 per cent). The decrease in the GDP growth rate is reflected in the potential growth rate, which was effectively halved between 2008 and 2009, falling by 0.3 percentage points. As a result the output gap, which measures the shift of the level of actual GDP vis à vis potential GDP (in relation to the latter), decreased markedly, going from approximately 0.8 per cent in 2008 to -4.5 per cent in 2009. (p.16)

> During the economic and financial crisis, the Italian Government took action immediately, albeit with fiscal prudence, both in the acute phase and subsequently as the first signs of stabilisation emerged and the economy began recovering. The budget strategy adopted by the Government focused on fiscal rigour, limiting discretional action to a minimum and allotting a significant share of public resources to automatic stabilizers**.** In line with this policy, during the 2008-2009 period the Government adopted temporary budget–neutral measures designed to have an impact on the real economy. (p.20)

Expenditure increasing measures in 2009 amounted to 0.66 percent of GDP. 23 percent of them included Subnational arrears settlement, 22 percent were car incentives and 15 percent were Family bonus.

In 2009, Italy receives a moderately expansionary fiscal score of -1 due to a relatively small size of the stimulus package in comparison with other developed countries.

Italy 2010: 0

From the 2010 Article IV report:

> The global crisis triggered Italy's worst recession since World War II. The downturn in Italy started earlier and lasted longer than in most of its euro area peers. Italy's reliance on exports and the predominance of SMEs increased its vulnerability to a global downturn. Additionally, the weak initial conditions and the decision not to engage in a large fiscal stimulus (which was appropriate in view of the high level of public debt) translated into one of the deepest output falls among large industrialized countries. (p.6)
>
> The high level of public debt constrained the government's ability to implement discretionary countercyclical fiscal policy. Italy's stimulus package included facilitating access to credit for small and medium-sized enterprises (SMEs), a car scrapping program, a one-off family bonus, and wage supplementation schemes. Overall, this was one of the smallest stimulus packages among advanced G–20 countries, reflecting the limited fiscal space available, the existence of large automatic stabilizers, and concerns that the market might have reacted adversely to an expansionary fiscal stance. (p.9)

From Article IV 2011 (p.8):

> The authorities comfortably achieved the 2010 fiscal target**.** The overall fiscal balance declined from 5.3 percent of GDP in 2009 to 4.5 percent of GDP in 2010 […], well below the target of 5.0 percent of GDP. The improvement reflected both good revenue performance and contained budget outlays. More stringent VAT refund rules introduced in 2010 reduced refunds by over €5.5billion (0.4 percent of GDP). The phasing out of the 2009 anti-crisis measures and cuts in capital spending and the wage bill contained outlays. Real primary current expenditure grew at the lowest rate since mid-1990s. However, payment delays increased. The positive budgetary trends continued in the first months of 2011. The structural balance improved by about 1 percentage point of GDP in 2010, among the largest improvements in the EA.

In 2010, the fiscal score is 0, as broadly neutral, reflecting the balance between some of the persisting stimulus measures and structural deficit reduction measures adopted in 2010.

Italy 2011-2013: all 2

According to the 2012 Statement of Executive Director for Italy (pp.1-2 of the Statement):

> On fiscal policy, the goal is to balance the budget in structural terms and to put the debt on a declining path by 2013. The measures enacted in the last 12 months represent a fiscal adjustment of about 5 percent of GDP and they aim to reduce the deficit from 3.9 percent in 2011 to 1.7 percent this year and to 0.5 percent in 2013. In structural terms, the deficit is expected to decline from 3.6 percent in 2011 to 0.4 percent this year and to achieve a surplus of 0.6 percent in 2013.
>
> In the short term, the bulk of the fiscal adjustment is taking place through tax increases; however, efforts were made to make fiscal consolidation as growth friendly as possible.
>
> Thus, the burden has been placed on consumption and property taxes. VAT rates were increased and a real estate tax abolished by the previous governments has been reinstated. Conversely, taxes have been reduced for companies hiring new employees and on capital investments in order to support economic growth.
>
> Further fiscal consolidation measures are expected through spending cuts; a comprehensive spending review has been launched with the objectives of reducing the overall level of government spending and improving its quality. The spending review broadens the efforts made in the past few years to curb current expenditures. Wages in the public sector have been frozen since 2010, while those of senior officials were cut by 10 percent.

A more detailed description of expenditure reducing and revenue enhancing measures during the period can be found in the 2012 Stability Programme (pp.12-17).

Although the fiscal stimulus during the crisis was not large, the fiscal position deteriorated and started to endanger the position of long-term public finances. Therefore, the authorities proceeded with a significant fiscal tightening in 2011-2013 which was one of the largest amongst the OECD countries, with the aim of putting the debt ratio on a downward trajectory. Therefore, the fiscal score is 2 during the period.

Italy 2014-2015: both 0

According to the 2014 Article IV report (p.26):

> The structural primary surplus improved from 0.7 to 4.5 percent of GDP between 2011 and 2013 and is now one of the highest in the euro area and close to its debt stabilizing level. Given the weak growth, the nominal headline deficit is expected to remain at 3 percent of GDP this year but fall short of a zero structural balance under Italy's new fiscal rule.

From Macroeconomic imbalances Country Report 2015 (p.8):

> The government deficit is expected to be 3 % of GDP in 2014 and 2.6 % in 2015, with overall no further improvement in the structural balance over these two years. The deficit is anticipated to have remained within the 3 % of GDP Treaty threshold in 2014, implying a marginal deterioration from the 2.8 % recorded in 2013.

The pace of fiscal consolidation eased after some tough adjustment. In line with the government's medium-term objective, the structural balance, which considers the ratio of borrowing to GDP net of the cycle and one-off measures, is forecast to be balanced by 2013 without any need for further corrective measures. The policy stance turned neutral in 2014-2015 and therefore the fiscal score is 0 in both years.

Spain

Spain 2006: 0

According to the 2006 Article IV report (p.4):

> The Spanish economy is enjoying a prolonged expansion. In 2005, Spain's economy grew by 3.4 percent and created more than 60 percent of all new jobs in the euro area.

The cyclically-adjusted balance is projected to remain at a surplus of about 1 percent of GDP for 2005-2008.

According to the 2006 Article IV report (p.4):

> In 2005 and 2006 the government has been working on three major fiscal reforms: the new Budget Stability Law (BSL), the income tax reform, and the pension reform, which shall further anchor a fiscal framework in the main following directions: The ongoing income tax reform, now in Parliamentary procedure, introduces a more streamlined and efficient income tax. The reform envisages a reduction of the corporate tax rate (down to 30 percent and to 25 percent for small and medium companies) better aligning it to European levels.

According to the 2005-2006 Stability Programme (p.30):

> The tax reform currently being studied is aimed at increasing equity, boosting efficiency and improving the environment. Consequently, the reform focuses on direct taxation by amending personal and corporate income taxation. In the framework of the recently-approved AVANZ@ Plan (to foster the development of the Information Society among citizens, businesses and the public administration, and to narrow the gap with the EU), the Ministry of Economy and Finance will consider extending the tax incentives for R&D and innovation investments.

Amongst main developments on the expenditure side:

> The priority given by economic policy to productivity entails an expenditure strategy which prioritises policies that most directly affect growth, such as R&D and innovation. The Ingenio 2010 Programme is aimed at encouraging the State, companies, universities and other research centres to 27 Stability Programme 2005-2008 increase R&D and innovation spending to 1.6% of GDP by 2008 and 2% by 2010, with the private sector contributing 52.5% by 2010. (2005-2006 Stability Programme, p.27)

Overall, the improvement in the fiscal balance was influenced by the favourable economic environment. The fiscal stance in 2006 remained neutral and received a score of 0.

Spain 2007-2008: both 0

According to the 2007-2008 Stability Programme the fiscal strategy that commenced with the 2005 Budget has the main goal to contribute to the sustainability of the growth model through budgetary stability and to enhance productivity, improve public services and foster growth with solidarity.

> On the expenditure side, priority is given to increasing the economy's growth capacity and productivity: expenditure on research and development, infrastructure and education. On the revenue side, further progress is made with reforms to make direct taxation more efficient, thus continuing with the 2006 reform. The MTO objective [SK: MTO is medium term objective], which was approved by the lower house of Parliament on 19 June, envisages a budget surplus for the public administrations as a whole amounting to 1.15% of GDP in each year of that three-year period. (2007-2008 Stability Programme, p.17)
>
> The changes in the primary structural balance, as an approximate indicator of the fiscal stance, show that the fiscal stance will be practically neutral or slightly expansive in 2007 and 2008, basically as a result of the tax reform. In 2009 and 2010, the primary structural balance will remain constant at 2.6 points of GDP, which will also contribute to the long-term stability of the public finances. (2007-2008 Stability Programme, p.21)

In 2007-2008, the authorities followed the programme that commenced in the 2005 Budget, meaning an approximately neutral fiscal stance. Therefore, the fiscal score was not changed and remained at 0.

Spain 2009: -3

From the 2008-2009 Stability Programme:

> This Update is presented in a radically different context from its predecessors. The intensification of the international financial crisis since September 2008 has required a coordinated, rapid and global response from all economies. In Spain, the impact of the housing sector adjustment is taking its toll, exacerbated by the global financial crisis itself. (p.4)
>
> Spain initially confronted the crisis from a relatively comfortable position, the result of fiscal consolidation in previous years and the sizeable reduction in government debt. This budgetary margin has enabled the Spanish economy to contribute decidedly to the European Economic Recovery Plan adopted by the European Council in December 2008, through the Spanish Economy and Employment Stimulation Plan. Specifically, the set of temporary measures with a direct fiscal impact in 2009 are expected to amount to 1% of GDP [SK: or 11.2 billion euro; Table 7 provides a description]. Coupled with permanent measures, involving lower tax rates and

> changes in the tax prepayment system to enhance the liquidity of companies and households, the fiscal stimulus estimated for 2009 amounts to 2.3% of GDP.
>
> The exceptional situation in 2009 leads to an estimated deficit for all levels of government amounting to 5.8% of GDP. (p.24)

According to the 2008 Article IV report, the main measures under the stimulus package consisted of PIT (personal income tax) reform; CIT (Corporate income tax) reform; wealth tax reform; and primary current spending pressures and public works.

Due to the implementation of one of the largest stimulus packages in international terms, the fiscal score is -3.

Spain 2010: 2

According to the 2009-2010 Stability Programme:

> In any event, the challenge facing the Spanish economy lies in implementing an ambitious exit strategy from the crisis which includes two main lines of action in addition to budgetary consolidation. On the one hand, the financial system must be strengthened to ensure that credit is effectively channelled to the private sector. On the other, there is the exit strategy for the real economy, which includes the necessary structural reforms to lay the foundation for robust, sustainable, balanced growth in the future. (p.3)
>
> The government's fiscal exit strategy combines firm curtailment of expenditure with a moderate increase in revenues. Subsequently, on 29 January 2010, the Government approved two plans to cut public spending in the sphere of the Central Government (the Immediate Action Plan 2010 and the Austerity Plan 2011-2013) and proposed two Framework Agreements with the Autonomous Communities and Local Governments.
>
> The Austerity Plan 2011-2013 and the Framework Agreements contain a range of new measures to reduce expenditure. The Austerity and Immediate Plans the 2009 Stability Programme -2013 together will account for the 4.3 percentage points of GDP that are the estimated fiscal consolidation requirement for general government as a whole. The main measures are detailed below:
>
> - A reduction in compensation of employees amounting to 1.9 points of GDP (equivalent to a 4% cut in nominal terms with respect to 2009).
> - Intermediate consumption, transfers and other expenses will be reduced permanently in the same period by 1 percentage point of GDP in a context of rationalisation of the working day and more effective use of material resources.
> - Gross fixed capital formation will decline by 0.9 points of GDP (excluding the transitory extraordinary funds), i.e. a 14% decline with respect

to 2009. Investment in infrastructure will be affected the least, but the impact will still be notable.

- Finally, subsidies will be cut by 0.5 points of GDP. (pp.25-26)

Table 4.2 in the 2009-2010 Stability Programme describes the consolidation measures of the central government in 2010 under the Immediate Action Plan 2010. Overall, due to their implementation the revenue was boosted by 1.4 per cent of GDP and expenditure reduced by 0.3 percent of GDP. Therefore, the fiscal score in 2010 is 2.

Spain 2011: 3

From 2010-2011 Stability Programme:

> One of the most adverse results of the crisis in Spain has been the deterioration of public finances, which placed the deficit at 11.1% of GDP in 2009. Although the initial situation was very favourable, the ratio of public debt to GDP was increasing significantly, so a decision was made to initiate the process of fiscal consolidation at the end of 2009. Furthermore, in the context of sovereign debt problems in the euro area, the Government decided to accelerate fiscal consolidation plans in May 2010.
>
> Thus, the target of the Spanish fiscal consolidation strategy is to achieve a deficit of 3% of GDP in 2013 and 2.1% in 2014. To do this, the intermediate budget targets are: a deficit of 9.3% of GDP in 2010, 6% in 2011 and 4.4% in 2012. The Programme establishes an annual fiscal effort in excess of 1.5% of GDP on average until 2013, more intense in 2011 (and in the year just ended, 2010). The fiscal consolidation process will continue up to the medium-term objective, which is still a cyclically adjusted balanced budget. (pp.4-5)
>
> In 2011, the improvement in the cyclical position of the Spanish economy will help reduce the deficit observed and, furthermore, the withdrawal of the transitory measures will be completed. Overall, the correction of the primary balance will represent 3.4 percentage points between 2010 and 2011 and 2.4 after adjusting for transitory measures. In the following years, the reduction of the structural component in the deficit becomes smaller, while the cyclical component will diminish before practically disappearing. (p.25)

A more detailed description of the consolidation measures planned for 2011-2014 can be found in the 2010-2011Stability Programme. Overall, the authorities take a very serious step towards stabilizing the public finances and the fiscal score is 3, meaning an adjustment of more than 2 percent of GDP.

Spain 2012: 3

According to the 2012 Article IV report:

> The economy has entered an unprecedented double-dip recession with unemployment surging over 24 percent. The modest recovery from the 2008–09 crisis gave way to a new slowdown in the second half of 2011 as financial tensions rose. By the end of the

first quarter of 2012, real output was some 3 percent below its 2008 peak, similar to Italy. (p.8)

The 2011 fiscal slippage was much worse than expected, underlining the challenges of fiscal consolidation at all levels of government. The 6 percent of GDP target was missed by almost 3 percent of GDP and the adjustment in 2011 was only 0.4 percent of GDP—even less adjustment than in 2010 and not due to worse macro conditions. The slippage is mainly (two-thirds) at the regional level, which did not adjust at all in 2011. (p.18)

On July 11, Prime Minister Rajoy announced a significant package of additional fiscal measures. Key measures include:

- VAT: the standard rate was raised from 18 to 21 percent and the reduced rate from 8 to 10 (the super-reduced rate was left unchanged at 4 percent). A number of products have also been moved from lower to higher rates. Other indirect taxes will also be raised.
- The extra payment in December to civil servants was suspended for 2012 — equivalent to nearly a monthly wage.
- The mortgage income tax deduction will be removed.
- Unemployment benefit was reduced (with the replacement rate after six months falling from 60 to 50 percent).
- Social security contributions are reduced by one percentage point in 2013 and a further point in 2014.

The new fiscal package, regional government actions, and structural measures, are broadly in line with staff recommendations. Staff's preliminary estimate is that the cumulative size of the package between 2012–14, as currently planned, is about 2 percent of GDP. (pp.2-3)

In the 2012 Stability Programme, the authorities mention an updated consolidation plan for the following years: In terms of the structural deficit in the previous programme an adjustment of 5.4 percentage points between 2011 and 2013 was expected, both years included. By 2012, the contraction of the structural deficit in those years is extended to about 5.8 pp.More specifically, the structural effort in 2012 alone amounts to about 3.8 percentage points, which, together with the 0.7 percentage points made in 2011, is already a more committed effort between the two years than planned in the 2011 Stability Programme .

Given an unexpected recession that hit the economy in the middle of 2011, the authorities realised the need for additional consolidation measures in order to put the public finances back on a sustainable path. Therefore, the fiscal score remained at 3 in 2012.

Spain 2013-2014: both 1

Overall, the consolidation proceeded in the way described in the 2012 Stability Programme, with an annual average adjustment of about 1 percent of GDP.

According to the 2014 Article IV report (p.24):

> Fiscal consolidation continued in 2013, but public debt is still rising […]. Even as the authorities sought to minimize the negative impulse to demand through a gradual adjustment, Spain still achieved a remarkable reduction of the fiscal deficit during 2012–13 in the middle of a recession. But the overall deficit is still very large, and debt, already above the Euro area average, is rapidly approaching 100 percent of GDP. Putting debt onto a firmly-declining path to reduce vulnerabilities, consistent with EU rules, requires maintaining a primary surplus of at least 2 percent of GDP. This entails improving the primary balance by some 6 percent of GDP compared with 2013, about the same as the improvement since 2009 (though macroeconomic conditions will likely be much more favorable).

Given some stabilization of the economy, the authorities proceeded with the consolidation established in the 2012 Stability Programme, envisaging a reduction in the speed of adjustment. Therefore, the fiscal score in 2013-2014 is 1.

Spain 2015

From the 2015 Article IV report (p.15):

> Continued coordinated and credible fiscal consolidation will help protect confidence and reduce vulnerabilities to potential adverse shocks. Any windfalls from higher nominal growth and lower borrowing costs should be used to bring the deficit down further. A pace of structural adjustment of around ½ percent of GDP per year would ensure debt is put firmly on a downward path.
>
> This will require a concerted effort across all government levels through more ambitious and better-specified measures than currently envisaged, while protecting the most vulnerable. Specifically:
>
> - Raising excise duties and environmental levies, and gradually phasing out value added tax (VAT) preferential treatments would bring Spain's collection efforts more in line with those of other European countries.
>
> - At the regional level, there is scope for additional efficiency gains and fiscal savings—for example, by reducing the costs of providing public health and education services.

Overall, the consolidation proceeded in 2015, however, the relative success of the previous years allowed the government to cut the speed of adjustment to about 0.5 percent of GDP annually. Therefore, the fiscal score is 1.

<u>Greece</u>

Greece 2006: 2

From the 2005-2006 Stability Programme:

> Potential growth is projected at 3.8% in the 2005-2008 period. Thus, we estimate that in 2005, Greece will achieve a cyclically-adjusted deficit of 5.5% of GDP, down from 7.8% in 2004. In the years ahead, it gradually falls and reaches 3.0% in 2008. The improvement of the cyclically-adjusted balance is quite substantial over the period, 2.3 percentage points in 2005, 1.1 in 2006, 0.9 in 2007 and 0.6 in 2008. (p.15)
>
> Ordinary budget primary expenditure in 2005 and in 2006 will rise by 5.9% and 6.4% respectively (as compared to a nominal GDP growth rate of 7.7%, and 7.4% respectively), while in 2004 primary expenditure grew at a rate of 15% (with nominal GDP growing at 8.4%). (p.18)
>
> For the first nine months of 2005 ordinary budget revenue increased only by 4.1% compared to the same period of the previous year. This has been a weak point in our effort for fiscal consolidation. It is mainly explained by extensive tax evasion. Indirect taxes (as a ratio to GDP) have been on a declining trend since 2000, when they accounted for 15.3% of GDP. In 2001 and 2002 this ratio was 14.8%, fell to 14% in 2003 and 13.8% in 2004 and is expected to reach 13% in 2005. (p.19)

Overall, consolidation on a large scale took place in 2005-2006. The adjustment in 2006 amounted to 1.1 percent, all of which was due to permanent measures. Therefore, the fiscal score of 2 is given to Greece in 2006.

Greece 2007: 1

From the 2006-2007 Stability Programme:

> The policies are already bearing fruit. In the course of 2 years, the general government deficit has been reduced by 5.2 percentage points of GDP mainly based on curtailing expenditure. The expected outturn of the 2006 State Budget is a deficit of 2.6% of GDP, thus bringing to an end the excessive deficit, in full compliance with the Council notice of 17 February 2005. (p.3)
>
> Fiscal consolidation has been a top priority for the Greek government. This effort has resulted in a reduction in the general government deficit from a high of 7.8% of GDP in 2004 to 2.6% of GDP this year. (p.10)
>
> Regarding the 2007 budget targets, a general government deficit of 2.4% of GDP for next year is projected. Compared to the 2006 budget expected outturn, the adjustment net of one-offs, is equal to 0.6 p.p. of GDP. A 0.2 p.p.of GDP improvement in ordinary budget revenue is expected. […] On the expenditure side, improvement is expected from interest payments, primary expenditure and ESA95 adjustments. […]
>
> Lastly, the medium term objective of fiscal policy is to reach a budget in balance or surplus by 2012 at the latest, with annual reductions in the structural deficit of at least 0.5 p.p. of GDP. […]
>
> In the years ahead, the cyclically-adjusted deficit falls gradually reaching 1.6% in 2009. The improvement in the cyclically-adjusted balance is quite substantial: 2.2 p.p. of GDP in 2006, 0.7 p.p. in 2007, 0.5 p.p. in 2008, and 0.6 p.p. in 2009. (p.13)

Overall, a consolidation continues but the rate of adjustment is diminished to about 0.6 percent of GDP. Therefore, the fiscal score changes to 1 in 2007.

Greece 2008: 1

From the 2007-2008 Stability Programme:

> This update to the Hellenic Stability and Growth Program is the first one after Greece's exit from the Excessive Deficit Procedure. […] The key fiscal objective of the Greek government as displayed in the present Program is to continue the reduction in the general government deficit by at least 0.5 p.p. of GDP in structural terms until we reach the Medium Term Objective. (p.3)
>
> The central government deficit in 2007 is estimated at 4.1% of GDP (on a budget basis) compared to the budgeted 3.95% of GDP. The general government deficit will be 2.7% of GDP compared to the budgeted 2.2% of GDP (due to unforeseen events). The reduction in the general government deficit to 1.6% of GDP in 2008 is significant both quantitatively and qualitatively. (p.18)
>
> The medium term objective of fiscal policy is to reach budget balance by 2010, with annual reductions in the structural deficit of at least 0.5 p.p. of GDP.
>
> We estimate potential growth at 4.0 % on average for the 2007-2010 period […]. Based on that estimate, the cyclically-adjusted balance net of one-offs and other temporary measures in 2008 will reach 2.6% of GDP, down from 3.7% in 2006 and 3.2% in 2007. In the years ahead, the structural deficit falls further to 0.8 % in 2010. The improvement in the structural balance is substantial: 0.5 p.p. of GDP in 2007, 0.6 p.p. of GDP in 2008, 1.0 p.p. of GDP in 2009, and 0.8 p.p. of GDP in 2010. (p.14)

The authorities followed the consolidation path described in the 2006-2007 Stability Programme and, therefore, the fiscal score was not changed and remained 1.

Greece 2009: 1

From the 2009 Article IV report (p.20):

> Greece is entering the downturn with an already weak fiscal position. Failures to stick to budget plans, deficit-increasing one-off measures, expenditure slippages, and ad-hoc revenue efforts have coincided with persistent deficits above 3 percent since 2000 […].

From the 2009-2010 Stability Programme:

> Fiscal developments in 2009 were characterized by a continuous deterioration of the general government deficit. The 2010 State Budget which was submitted to Parliament in late November 2009 recorded an **e**stimated general government deficit of 12.7 percent of GDP for 2009. This significant deviation of the general government deficit from the initial (2 percent of GDP in the 2009 budget, and 3.7 percent of GDP in the SGP submission) and mid-term forecasts (5.1 percent of GDP mid-year) can be attributed to the following three effects. (p.14)

> The deterioration of the general government deficit by 10.7 percentage points of GDP reflects mainly revenue shortfalls of 3.4 percent of GDP and expenditure overruns of 2.6 percent of GDP, due to the above effects. An additional deterioration of the deficit by 2.1 percent of GDP is due to the significant revision of GDP, which was estimated for the year 2009 at €260,248 million in current market prices and was used for projections in the 2009 Budget, but was later revised to €240,150 million. Another 0.9 percent of GDP deterioration in the deficit was due to the inclusion of the general government's liabilities to the private sector (public hospitals arrears to suppliers). (p.16)

Overall, it seems that the deterioration of the budget balance was purely cyclical. This was due to negative revenue and expenditure surprises as well as multiple revisions of potential GDP. The official structural budget deficit figures do not reflect the decisions of the Greek government. In fact, there was no discretionary stimulus package and therefore the fiscal score was not changed and remained at 1.

Greece 2010: 3

From the 2010-2011 Stability Programme:

> The 2009 general government deficit was revised upwards by 1.8 p.p. of GDP (from 13.6% to 15.4%) and the 2009 debt was revised by 11.7 p.p. (from 115.1% to 126.8%). […]
>
> The general government deficit reduction which was finally achieved amounted to 5 p.p. of GDP (from 15.4% in 2009 to 10.5% in 2010), an improvement which fell short the initial target of 5.5 p.p. mostly due to an inter-quarter shift in recession that reduced tax receipts and social security 21 contributions corresponding to end of 2010 economic activity. (pp.20-21)
>
> The deficit reduction in 2010 is mainly due to the significant reduction of expenditure; more specifically, ordinary budget expenditure declined by 9.9% year-on-year, while primary expenditure decreased by € 6,387 million or 11.0%. Investment budget expenditure decreased by 11.9%, while interest expenditure increased by 7.3%. State Budget (ordinary and investment) expenditure decreased by 10.1%. Developments on the expenditure side of the budget show a significant permanent step to overturn the trend of recent years. (p.22)
>
> Fiscal adjustment in 2010 was achieved through a combination of measures drawing almost equally on both the expenditure side and the revenue side of the budget. Recession in the economy and fiscal consolidation seem to be calling for the implementation of measures that contradict each other (being expansionary and contractionary respectively), but fiscal imbalances are on an unsustainable track which needs to be taken care immediately, whereas recession is the downturn of an economic cycle. (p.21)

Given a large-scale consolidation programme implemented amidst the recession with the objective of restoring public finance sustainability, the fiscal score of Greece in 2010 is 3.

Greece 2011: 3

From the 2010-2011 Stability Programme (p.23):

> The improvement of tax collection remains a crucial element in the second year of the program, not only given its direct impact on fiscal accounts, but also on tax equity grounds. In March 2011 legislation was passed to fight against tax evasion, to accelerate and reinforce actions against tax evaders, to increase the efficiency of the tax collection mechanism and to accelerate tax-related court cases.
>
> Following the reduction of the general government deficit by 5.0 p.p. in 2010, the target for 2011 is to reduce the deficit further by 3.2 p.p. (that is a reduction of the deficit from 10.5% in 2010 to 7.3% in 2011) or about € 7.8 bn (from € 24.2 bn to € 16.4 bn). Despite the smaller reduction compared to 2010, as measured in GDP percentage points, the fiscal consolidation effort will be of the same magnitude.

Large-scale consolidation continued in 2011, and therefore the fiscal score was not changed and remained at 3.

Greece 2012-2015: all 2

According to the 2013 Article IV report:

> The recession has been one of the deepest peacetime recessions in industrialized economies […]. Overall, the economy contracted by 22 percent between 2008 and 2012 and unemployment rose to 27 percent; youth unemployment now exceeds 60 percent. As domestic demand shrank across all categories, net exports provided support largely through shrinking imports.
>
> In response, an ambitious multi-year adjustment program was put in place. Greece has achieved one of the largest fiscal adjustments to date.
>
> The primary adjustment in 2010–12 amounted to 9 percent of GDP, and was much higher (15 percent of GDP) in cyclically-adjusted terms. Following a major cut in public sector wages and pensions in 2010, measures in 2011 relied mostly on tax increases. But the new government has refocused the fiscal consolidation on deep expenditure cuts, including to wages and pensions. These cuts have been socially painful, but necessary, given that these expenditures were the primary source of spending pressures leading up to the crisis.
>
> The program fiscal path targets headline primary adjustment of 1.5 percent of GDP per year, terminating in a surplus of 4.5 percent in 2016. It is further assumed that Greece can maintain a long-term primary surplus of 4 percent of GDP. This fiscal path is ambitious, but, in terms of dynamics, almost all of the adjustment will be behind Greece at the end of this year. Maintaining a 4 percent primary surplus will remain a challenge: while there were episodes of large sustained primary surpluses in the past, they were rare and often occurred in extraordinary circumstances (e.g., before the euro accession).

Overall, the major part of the fiscal response to the debt crisis was in 2010-2011. From 2012, the authorities reduce the speed of consolidation to about 1.5 percent of GDP. Therefore, the fiscal score during 2012-2015 is 2.

Denmark

Denmark 2006-2007: both 0

Despite record high budget surplus, the authorities emphasize that these achievements were due to favourable economic conditions and that there is no scope for an easier policy stance. From the 2006 Convergence Programme (p.6):

> The public balance (based on national account principles) showed a record high surplus of 4.6 per cent of GDP in 2005 benefiting, in particular, from a strong cyclical position and unusually high revenues from the taxation of North Sea oil and gas activities as well as the tax on financial returns on pension savings**.** In 2006 and 2007 the surpluses are also larger than might be expected under normal conditions. In the convergence programme, the budget surplus gradually approaches a structural level just above 1 per cent of GDP by 2010 as contributions from the present cyclical strength and other transitory factors wane. The structural balance is in line with the medium-term objective (MTO) requiring surpluses between ½ and 1½ per cent of GDP from 2005 to 2010.

Considering these facts, the fiscal stance of Denmark in both 2006 and 2007 receives score 0.

Denmark 2008: 0

The Danish economy approached the financial turmoil at high levels of employment and economic activity. Therefore, the government set out the objectives for future fiscal policies.

From the December 2007 Convergence Programme (p.11):

> - The policies that are planned towards 2015 as concerns public expenditure, taxation and structural policies can be sustained thereafter without fiscal adjustment.
>
> -Structural budget surpluses in every year towards 2015. The requirement of fiscal surpluses, or at least balance, is an objective in its own right alongside (and in accordance with) the requirement of fiscal sustainability.
>
> The operational target for structural surpluses of between ¾ and 1¾ per cent of GDP towards 2010 and at least balance towards 2015 is in accordance with the EU Stability and Growth Pact.

By the end of the summer of 2007, the persistent turbulence has affected the financial markets, but the effect on the real economy is not yet clear. Overall, the reduction in the budget surplus in 2008 can be explained by cyclical factors. Since there was no structural change in public balances, the fiscal stance remained neutral in 2008 and it receives the same score as in previous years.

Denmark 2009: -3

The turmoil in the financial markets has significantly affected the state of the budget balance in 2009. According to the December 2008 Convergence Programme (p.6):

> Public finances will deteriorate markedly in 2009 and 2010. The estimated fiscal surplus of around 50 billion DKR in 2008 (3 per cent of GDP) is expected to turn into balance in 2009 and a deficit of around 25 billion DKR in 2010 (1¼ per cent of GDP).
>
> The deteriorating fiscal balance partly mirrors the financial turmoil, including the drop in oil and equity prices which sharply lowers the income from specific revenue sources. The structural surplus is largely unaffected by cyclical changes and swings in oil and equity prices etc., but active fiscal policy decisions lower the structural surplus by close to 1 per cent of GDP in 2009.

Later the size of the discretionary stimulus was revised up to 2.7 percent.

Given a large discretionary stimulus and the fact that the automatic stabilizers were allowed to operate in full, and their size is large compared with the majority of OECD economies, the fiscal stance in 2009 receives score -3.

Denmark 2010: -2

From the 2010 Article IV report (p.4):

> Fiscal policy delivered some 4 percentage points of GDP in discretionary stimulus in 2009–10. Roughly two thirds of the stimulus was implemented in 2009, with measures focused on the expenditure side—higher public consumption, subsidies and transfer payments—but also income tax cuts in the context of a major tax reform. Also reflecting large automatic stabilizers, the general government balance swung from a surplus of 3.4 percent of GDP in 2008 to a deficit of 2.8 percent of GDP in 2009. In 2010, the stimulus comprised additional income tax cuts and higher-than-budgeted growth in public consumption and investment, and the deficit is projected to further widen to around 5 percent of GDP.

Since the fiscal stimulus programme continues in 2010, and the size of discretionary support is estimated to be larger than 1% of GDP but less than 2%, the fiscal stance in this year receives score -2.

Denmark 2011: 0

In 2011, Denmark turns from fiscal support to the process of gradual consolidation of the budget balance. Overall, the authorities project higher interest payments on debt, adverse demographics and falling North Sea revenues to offset the withdrawing of temporary support. From European Commission Working Staff Paper 2011 (p.7):

> The consolidation strategy is largely expenditure-based. The expenditure-to-GDP ratio is planned to decrease by 4.7% of GDP over the period 2010-2015. The [Convergence Programme] projects social expenditure to decrease thanks to the continued economic recovery and the government's tighter control of budgetary execution. Moreover, compensation of public sector employees is to be reduced by

> 1.5 % of GDP between 2010 and 2015. Revenues as a percentage of GDP are forecasted to decline by 2.6% over the programme period due to lower returns from income and wealth taxes, in line with the 2010 tax reform, and lower social contribution following the phasing out of the VERP [SK: voluntary early retirement pension] from 2012 onwards.

Overall, since the recovery began to falter in 2011 and automatic stabilizers were allowed to support the economy in full, the fiscal stance received score 0 as neutral.

Denmark 2012: -1

Fiscal policy has been supportive as the recovery began to falter in 2011. According to the 2012 Article IV report (p.5):

> The 2012 budget deficit is expected to widen to 4.2 percent of GDP from 2.0 percent in 2011, reflecting one-off stimulus measures, repayment of early retirement contributions and slower than expected growth. The stimulus measures included an acceleration of capital spending into 2012 and 2013, "balanced budget" stimulus through off-budget public enterprise infrastructure to be funded by higher prices and tariffs, and various other budgetary measures. […]

At the same time, Denmark carries out a number of consolidation measures in order to improve the public finances. In 2012, though, the structural balance is temporarily reduced by 0.5 per cent of GDP. For the detailed description of the fiscal policy measures to comply with EU recommendations the reader is referred to the 2012 Convergence Programme.

Throughout 2012 the authorities allowed the automatic stabilizers to operate in full and introduced a stimulus programme to support the economy during the slowdown. Therefore, the fiscal stance in 2012 receives the score -1.

Denmark 2013: 1

As the economy begins to recover again, the authorities resume the consolidation measures. From the 2013 Convergence Programme (p.28):

> The structural budget balance which is corrected for the impact of business cycle developments and other temporary factors (including developments in financial markets and oil prices) is estimated to -0.9 per cent of GDP in 2011, -0.8 per cent of GDP in 2012 and -0.2 per cent of GDP in 2013. Under EDP the public deficit is brought below 3 per cent of GDP in 2013, [...], and the structural budget balance improves by approximately 1½ per cent of GDP in the period 2011 to 2013, […]

The estimated effect of the consolidation measures in 2013 amounted to 0.6 percent of GDP (a detailed description of the measures can be found in the 2013 Convergence Programme). Therefore, the fiscal stance of Denmark in 2013 receives score 1.

Denmark 2014-2015: both 0

From 2014 the authorities realize that the 2011-2013 consolidation has been successfully implemented, and turn to a broadly neutral stance (described by fiscal score 0). From the 2014 Convergence Programme (p.3 and p.26):

> The actual government budget deficit has been brought below 3 percent of GDP and public finances have in structural terms been improved by 1½ percent of GDP in the period 2011-13. Based on the planned fiscal policy the structural balance is in line with the medium-term objective (MTO) for the structural balance of -0.5 percent of GDP. (p.3)
>
> In 2014, the structural deficit is estimated to 0.6 per cent of GDP, and in 2015 the deficit is expected to amount to 0.4 per cent of GDP, […]. Fiscal policy is planned within the framework of the Budget Law, including the limit for structural deficits of ½ per cent of GDP. (p.26)

Belgium

Belgium 2006: -1

As described in the 2006 Stability Programme (pp.21-22),

The local elections in 2006 cause the local government balance to deteriorate, in view of the electoral cycle of their expenditure. Their 2006 deficit is estimated at 0.2 % of GDP. Conversely, the accounts of the communities and regions, social security and – for the first time – federal government show a small surplus. The government pursues an active fiscal policy aimed at stimulating job creation in Belgium. Apart from the cut in personal income tax already mentioned, which will take full effect in 2006, this policy designed to boost activity will continue in 2006.

Overall, due to a combination of structural measures to improve the economic potential, the fiscal stance in 2006 was moderately expansionary, and was given a score of -1.

Belgium 2007-2008: both 1

In the first half of 2006, the economic activity strengthened considerably both in the euro area and Belgium. The authorities took this opportunity to strengthen the fiscal position in the face of long-term challenges such as a high debt ratio (of about 100% GDP) and aging. As stated in the 2007 Stability Programme:

> In 2000, a lengthy period of deficits came to an end. In the period which followed, owing partly to weak economic growth, the central aim was to safeguard the balance. It is necessary to reduce the debt at a sufficiently rapid pace to allow for the expenditure relating to population ageing. That is why the government is opting for the progressive creation of surpluses. A first step in that direction was taken by the 2007 budget, which provides for a surplus of 0.3 % of GDP. (p.23)
>
> Public service spending is subject to stringent monitoring. Thus, the total primary expenditure of the federal government cannot increase by more than 2.3 % in real

> terms. The ratio of general government primary expenditure to GDP will decline by 0.2 percentage point. (p.24)

The budget for 2008 was negatively influenced by external factors. For instance, the economic climate was less favourable than in previous years. According to the 2009 Stability Programme (p. 10):

> Growth in real primary expenditure of the federal government was limited to 1.9% (in budget terms). Considering the challenge posed by population ageing, the government plans to attain structural surpluses from 2009 onwards, with the balanced budget in 2008 as a starting point.

Due to the positive economic environment in previous years, the authorities realized that it was time to concentrate on long-term issues such as debt reduction and ageing. The fiscal stance turns out to be moderately tightening and is given a score of 1.

Belgium 2009: -2

In 2009, the deficit of 5.9% of GDP has to be viewed in the context of the sharp deterioration of the macroeconomic background. According to the 2009 Stability Programme, the discretionary stimulus can be estimated at least around 1% of GDP in 2009. In addition, the government allowed the automatic stabilisers to operate to the full.

According to the 2009 Stability Programme, the revenues dropped by 4.3% compared to 2008, mainly because income tax fell by 7.4% and corporate taxes by 25.5%. In terms of primary expenditure, a significant rise of +6.1% was recorded in 2009 compared to 2008. This rise is particularly significant for social security (+6.3%), taking account notably of the impact of the economic crisis on expenditure for unemployment (+15.1%) and the beginning of the effects of the ageing of the population. Also, the lagged effect of the rising prices manifested itself in an increase in salaries and social benefits.

Given the relatively large size of the automatic stabilizers in Belgium and a substantial budget expansion in 2009, the fiscal score in this year is -2.

Belgium 2010: -1

The authorities realized that the deficit of 5.9% GDP could not be sustainable. However, in this phase of the crisis, it was important not to undermine the revival of confidence and throw away the foundations of a lasting economic recovery. “A number of measures taken in the context of the stimulus plan will achieve their full effect in 2010. In order to create the financial margin for firms, they have not only been granted temporary payment facilities in 2009 with regard to fiscal and parafiscal debts, but complementary measures have also been taken in order to reduce the cost of labour. The exemption from payment of employee withholding tax has been raised, specifically from 0.25% to 0.75% in 2009 and to 1% in 2010.

> The extension of anti-crisis measures has been supplemented by a series of new initiatives focused on stimulating economic activity, particularly the labour market,

> and supporting purchasing power. The reduced rate of VAT in the building industry has been extended. (2010 Stability Programme, p.41)
>
> The reduced rate of VAT in the building industry has been extended. (2010 SP, p.42)
>
> The budget outcomes for 2010 are considerably better than the targets set in the 2010 Stability Programme, with a general government deficit of 4.1 % of GDP, compared to the original figure set at 4.8 %. (2011 Stability Programme, p.9).
>
> The improvement in the structural balance in 2010 ranged between 0.8 % of GDP and 1.3 % of GDP, depending on the methodology used. (2011 SP, p.10).

Overall, despite some consolidation measures, the fiscal stance remained supportive and is described with a score -1 in the classification.

Belgium 2011: 1

The European Council of 2 December 2009 recommended that the Belgian government should put an end to the excessive deficit procedure in 2012 at the latest by making a structural effort averaging 0.75 % of GDP per annum. At the federal level, despite its caretaker status, the government decided to take the necessary measures to comply with the European requirements by placing the emphasis partly on expenditure control and partly on optimising the collection of public revenues and stepping up the control of social security fraud and tax evasion. The measures taken at the federal level amount to 0.6 % of GDP. A detailed decomposition of the measures taken in 2011 is given in the 2011 Stability Programme (p. 24).

Overall, as the economy emerged from the recession, the fiscal stance turned from being supportive to a gradual consolidation. Due to Belgium avoiding significant shocks, the authorities managed to maintain the pace of consolidation at least until 2015. Therefore, the fiscal score stays constant at 1 during the period from 2011-2015.

Belgium 2012: 1

> In 2011, the deficit was brought down to 3.7% of GDP (2.8% in structural terms). This is in line with the target in the stability programme for 2011-2014 (3.6% of GDP). Broadly the government in its consolidation efforts followed the recommendation of the European Council. The aim of a deficit amounting to 2.8% of GDP in 2012 was confirmed and an additional budgetary effort of €1.8 billion, shared equally between revenue and expenditure, was achieved in order to fulfil that aim. That commitment was included in the federal government agreement, and implies that the federal government undertakes to limit the Entity I deficit to 2.4% of GDP. It also means that the Entity II levels of power must keep their deficit down to maximum 0.4% of GDP. (2012 Stability Programme, p.21)

Belgium 2013: 1

From the 2013 Stability Programme (p.1):

> At the time of the March 2013 budget review, the federal government decided to gear its fiscal policy to the structural budget balance, in line with the new European budgetary policy and regulations on the subject. The government is committed to cutting the structural deficit by 1% of GDP in 2013.

Despite this fiscal effort, the headline deficit rose from 3.7 percent of GDP in 2011 to 3.9 percent in 2012, reflecting not only cyclical factors but also a further recapitalization of the Dexia Group in late 2012 amounting to 0.8 percent of GDP.

The improvement in the structural deficit was achieved through revenue measures of 1.3 percent of GDP and by containing the growth in primary spending to 0.9 percent in real terms. Expenditure containment was achieved by a marked reduction in public service employment at the federal level (about 3 percent), lower subsidies to companies, and cuts in purchase of goods and services.

The 2013 budget (adopted in November 2012) targeted a deficit of 2.2 percent of GDP, consistent with the medium term objective of reaching a balanced fiscal position by 2015, but was based on optimistic growth projections. Based on the outcome of the 2012 budget, updated macroeconomic assumptions, and a revised fiscal assessment of subnational governments, the November budget would have resulted in a structural primary adjustment of only 0.1 percent of GDP relative to 2012, and a headline deficit of 3.3 percent of GDP in 2013.

Belgium 2014: 1

> Structural fiscal adjustment of 3.3 percent of GDP is still required to meet the authorities' medium-term structural surplus objective of 0.75 percent of GDP. The targeted surplus would place the debt ratio on a path consistent with EU commitments and create fiscal space for the looming cost of ageing. The April 2013 Stability Program envisioned reaching this objective in 2016. Meeting this target date would require an acceleration of adjustment by the federal and regional governments relative to the structural adjustment projected in 2014 under current policies (0.5 percent of GDP). (2014 Article IV report, p.15)

Belgium 2015: 1

The path to be followed throughout the government sector, as presented by the Borrowing Requirements Section, was based on the budget plan that was transferred to the European Commission in October 2014. This path was based on the multi-annual objectives of the federal, community and regional governments and aimed at a structural and nominal balance by 2018. The plan for 2015 was to improve the structural balance by 0.7% of GDP. The detailed decomposition of targets at different budget levels can be found in the 2015 Stability Programme.

<u>Netherlands</u>

Netherlands 2006: -1

From the 2005-2006 Stability Programme (p.15):

> Between 2003 and 2006 the structural balance - taking account of a delayed impact of the economic cycle on income and expenditure – will improve by an average of 0.5 percentage point, notably reflecting the significant narrowing of the actual deficit. Now, the Cabinet could return to trend-based fiscal policy in the 2006 budget. E.G., scrapping tuition fees and increasing child care subsidies to stimulate labour supply, EUR 1 billion was returned in tax cuts, additional tax cuts of EUR 0.9 billion, mainly to benefit households.

From the 2006 Article IV report (p.10):

> The fiscal stance for the remainder of the government's term may turn somewhat expansionary. The budget implies a roughly neutral fiscal stance in 2006. But preliminary plans suggested that fiscal policy—reflecting business-related tax cuts and various expenditures on economic structure and security, and to raise the purchasing power of lower income groups—would turn somewhat expansionary in 2007 (deteriorating structurally by 0.3 percentage point of GDP according to staff estimates). In light of longer-term fiscal requirements and with the upturn under way, staff urged the authorities to pursue at least a neutral stance. At a minimum, staff urged that any revenue overperformance or below-budget expenditures outturns for cyclical reasons go to deficit reduction—an approach the authorities already had in mind.

After a period of consolidation in 2003-2005, the 2006 Budget implied a moderately expansionary stance, with the structural deficit increasing by about 0.4 percent of GDP. Therefore, the fiscal score is -1 in 2006.

Netherlands 2007: -1

From the 2007 Article IV report:

> The discussions took place against a background of strong economic performance. The recovery is firmly entrenched […]. Recent economic growth compares favorably in a European context. […]
>
> Recent fiscal performance was impressive [...]. The general government balance shifted from a deficit of 3.1 percent of GDP in 2003 to a surplus of 0.6 percent of GDP in 2006. This adjustment had a large structural component, estimated by staff at over 3 percentage points of GDP. (p.4)
>
> The new government announced a target of a general government structural surplus of 1 percent of GDP by the end of its term (2011). (p.9)
>
> The near-term fiscal stance is a concern. Fiscal stimulus this year would be unhelpful in a context of emerging resource constraints. Thus, it is advisable to tighten the fiscal stance as soon as possible, both by locking in any unexpected saving in 2007 and in the context of preparing the budget for 2008. (p.16)

Against the background of strong economic performance and having achieved the budget targets, the authorities continue the fiscal easing. The structural balance deteriorated by about 0.3-0.4 percent of GDP in 2007. Therefore, the fiscal score remained at -1.

Netherlands 2008: 1

From the 2007-2008 Stability Programme (pp.12-13):

> In February 2007 a new Cabinet ("Balkenende-IV") started its 4-year term. The Budgetary Memorandum 2008 of September 2007 (the draft 2008 budget) further elaborated the budgetary policy and rules for the years 2008-2011.
>
> In 2007 a structural deficit of -0.3% of GDP is expected. Based on the information available at the time of the Budget Memorandum, the goal of a structural surplus of 1% of GDP will be achieved in 2011, while the balance is expected to improve each year in the 2007-2011 period.

According to the 2008-2009 Stability Programme:

> The short-term economic outlook for the world and Europe is clouded, due to significant downside risks associated with the current developments on the financial markets and their impact on the real economy. (p.6)
>
> The Dutch economy is facing uncertain times. Lack of clarity about the length and depth of the current crisis has clouded the economic outlook significantly. The baseline forecasts indicate that economic growth in 2008 will still amount to 2.25%, which is just above potential growth. The Cabinet aims for a structural budget surplus of 1 percent of GDP in 2011, this is above the medium-term objective (MTO). For 2008 a structural surplus of 0.9% GDP is expected. The goal of a structural surplus of 1% GDP in 2011 will be achieved according to Budget Memorandum 2009 and also in the years before a surplus close to 1% GDP is expected. (p.16)

The authorities realized that the fiscal expansion in 2006-2007 posed the fiscal position under risks. In the 2007-2008 Stability Programme the authorities expected the structural balance to be improved by 0.7, which is why the fiscal score is 1 in 2008.

Netherlands 2009-2010: -2 and 1

According to the 2009 Article IV report:

> The Dutch economy was particularly exposed given its relatively large financial sector and strong global trade and financial linkages […]. Thus, while growth attained 2 percent in 2008 overall thanks to a large carryover from 2007, it turned negative already in 2008:Q2. The contraction intensified until mid-2009, resulting in an unprecedented 5 percent fall by 2009:Q2. (reduced to 3¾ percent in 2009:Q3, year-on-year). (p.7)
>
> Large fiscal deficits of 4½ percent of GDP and 6 percent of GDP are expected in 2009 and 2010, respectively, reflecting the cyclical downturn, as well as structural

> relaxation. Public debt has surged as a result of the ongoing budget relaxation and the financial sector assistance. (Executive Board Statement, p.2)
>
> Amid a massive economic downturn, policy makers have shifted priority to support growth through fiscal policy. Fiscal impulses of 2½ and ½ percent of GDP are estimated respectively for 2009 and 2010. Discretionary stimulus measures provide for unemployment alleviation; investment in infrastructure, housing, and the environment; and transfers, subsidies and tax allowances for businesses, especially small and medium-sized ones. (p.22)

From the 2009-2010 Stability Programme:

> An initial economic stimulus package dating from 21 November 2008 was aimed at supporting the business sector by i) temporarily allowing accelerated depreciation (hence temporarily alleviating the tax burden), ii) stimulating the provision of credit to small and medium enterprises (SMEs), iii) reducing the period of payment by government agencies wherever possible, and iv) lowering the corporate tax for SMEs. This initial package also included measures for the labour market aimed at reducing the risk and duration of unemployment. (p.17)
>
> On 16 January 2009, the government announced a second stimulus package. The export credit insurance (EKV), the SME Guarantee Scheme and Growth Facility were expanded to support the functioning of the credit market. In addition, the scope of the Social Housing Guarantee Fund was broadened and building plans for health care institutions were supported. (p.18)
>
> A third package was announced on 25 March 2009 […]. This policy package was designed to supplement the coalition agreement, named ´Working on the Future´. In this policy package, the government presented its main response to the global economic crisis. […]
>
> The policy measures do not only focus on crisis management in the short-term, but also spell out the building blocks for a credible exit strategy in order to return to healthy and sustainable public finances in both the medium and longer term. (p.19)

According to the 2009-2010 Stability Programme the structural deficit was expected to be 3.5 percent of GDP in 2009 and 4.7 percent of GDP in 2010. This marks a large increase of official structural deficit compared with 2008 level of 0.4 percent of GDP. However, these estimations were influenced by the potential output and, in fact, the discretionary effort was not as large. Therefore, the fiscal scores are -2 in 2009 and 1 in 2010.

Netherlands 2011: 1

From the 2011 Stability Programme (p.5):

> As reported in the notification to Eurostat, the deficit figure for 2010 turned out better than expected in last year‘s update of the Stability Programme, namely 5.4% of GDP instead of 6.1% of GDP. The main reason of this improvement is the better than

expected outcome for growth, that resulted in higher tax revenues and social security contributions.

Based on the measures mentioned in the Coalition Agreement, the structural balance is foreseen to improve from -4.2% of GDP in 2010 to -1.3% of GDP in 2013, i.e. an average annual structural improvement of almost 1% of GDP. This means that the recommended average annual fiscal effort of at least ¾% of GDP over the period 2011-2013 will be achieved. In 2015 the MTO of a structural deficit of at least -0.5% of GDP is expected to be reached, implying an average yearly structural improvement of ¾% of GDP over the period 2010-2015.

In 2011, the authorities start consolidating the public finances. Considering the rate of annual effort, the fiscal score is 1.

Netherlands 2012-2013: both 1

From the 2012 Stability Programme:

Based on a deficit of 3% in 2013, the structural balance is foreseen to improve from -3.9% of GDP in 2010 to -1.3% of GDP in 2013, i.e. an average annual structural improvement of 0.9% of GDP. The recommended structural improvement of the budget balance of ¾% of GDP over the period 2011-2013 will thus be achieved. The government intends to further improve the budgetary position towards the Medium-Term Objective (MTO) after 2013, improving the average annual structural deficit further by at least 0.5%, in line with the preventive arm of the Stability and Growth Pact. (p.6)

In addition to a reduction in the nominal deficit in the short term, the Netherlands also aims for a smaller structural deficit in the medium term. In 2014 and 2015 the aim is to reduce the structural deficit by on average 0.5% each year. […]

For 2013-2015, the projected structural balance is worse than projected in last year's Stability Programme update although the projected growth in GDP is more or less the same. That the structural balance has deteriorated, although the government has not changed its consolidation package, is because there have been set-backs on the revenue side that have a structural nature. These set-backs are larger than what would be expected on the basis of the economic situation. (p.19)

From the 2013 Stability Programme (p.18):

Since the analysis of the Coalition Agreement by the CPB in November 2012 the budget position has worsened due to a number of unforeseen circumstances. The key reason for this is the disappointing growth realised in 2012 (which continued into 2013) and the negative adjustment of the outlooks for 2013 and 2014 compared to the expectations at the time the Coalition Agreement was entered into. This has led to a decrease in tax revenue and an increase in social security spending. In addition, steps were taken to prevent the bankruptcy of SNS REAAL, which would have been a shortfall on the expenditure side. This contrasts with the windfall on the income side

due to the revenue from the auction of 4G frequencies. In net terms this windfall and shortfall cancel each other out.

Overall, the authorities followed the consolidation plan described in the 2011 Stability Programme. The authorities remained committed to reduce the structural deficit by approximately 0.75 percent of GDP annually until 2015, with a slightly higher rate before 2013. The fiscal score, therefore, remained at 1 in both 2012 and 2013.

Netherlands 2014: 1

In 2013, due to the worsening economic situation, the Netherlands was given an additional year in which to end the excessive deficit. The Commission was of the opinion that the Netherlands had taken effective action by improving the structural balance in the period 2011-2013 by an average of 1.1 percent GDP per annum. According to the new recommendation, new structural consolidation measures were necessary for the Netherlands in 2014, equivalent to 1 percent of GDP on top of the baseline scenario.

In addition to a reduction of the government deficit in the short term, the Netherlands is also focusing on reducing the structural deficit in the medium term. In 2014, the structural budget balance is estimated to be -1.2 percent of GDP. In 2015, this balance is expected to improve to -0.8 percent of GDP, which is close to the medium-term objective of -0.5 percent of GDP for the Netherlands.

Despite a slowdown in economic activity, the authorities remain committed to their medium-term targets. Due to the additional fiscal stimulus, the fiscal score remains at 1.

Netherlands 2015: 0

According to the 2015 Article IV report:

> A moderate recovery is underway after a double-dip recession that ended in early 2014. Growth is expected to rise from 1.0 percent in 2014 to about 2 percent in 2015 and 2016. GDP growth slowed sharply in 2015:Q2 as natural gas production and exports have been cut because of seismic events in the gas production region. This reduced growth by half a percentage point in 2015. Domestic demand continues to strengthen at a moderate pace. (p.4)
>
> Fiscal policy was broadly neutral in 2015 and is expected to slightly tighten in 2016. The recovery helped keep the headline deficit relatively stable in the 2.2–2.4 percent of GDP range in 2013–15, with a slight deterioration in the structural balance. The draft 2016 budget reduces labor and income taxes by €5 billion (about 0.7 percent of GDP) while pursuing the expenditure-based path of fiscal consolidation. Both the headline deficit and the pace of debt reduction are comfortably within the Stability and Growth Pact (SGP) limits. There is fiscal space in economic terms, but perhaps less in SGP terms. Staff calculations show a structural deficit only slightly larger than the MTO of a 0.5 percent of GDP deficit, based on output gap estimates in line with the authorities' ones. (pp.8-9)

After a prolonged period of consolidation, the fiscal stance turned neutral in 2015. The fiscal score is, therefore, decreased to 0.

Canada

Canada 2006: -1

> Canada has achieved eight consecutive years of federal surpluses and falling government debt, creating a strong social consensus for prudent fiscal policies. (2006 Article IV report, p.14).

According to the 2006 Budget Plan (p.21):

> For 2005–06, the federal surplus is currently estimated at $8 billion. Starting this fiscal year, the Government is planning on achieving annual debt reduction of $3 billion. The Government is directing higher than expected surpluses over the planning period to the priorities of Canadians, largely to reducing taxes. As a result, revenues as a share of gross domestic product (GDP) are projected to decline from 16.4 per cent in 2004–05 to 15.5 per cent in 2007–08.

In particular,

> Tax cuts pledged during the campaign included a 2 percentage point reduction in the goods and services tax (GST), with the first percentage point to be implemented immediately, and cuts in a range of taxes on business over the coming five years. (2006 Article IV report, p.15)

Overall, Canada maintains fiscal prudence in 2006. The introduction of tax cuts in 2006 means that fiscal stance in 2006 receives score -1.

Canada 2007: 0

In 2007, fiscal policy followed the trend established in 2006.

> Fiscal policy is appropriately focused on further reducing debt, lowering taxes, and reforming federal-provincial transfers. However, reducing effective marginal tax rates on investment would provide larger efficiency gains than further cuts to the Goods and Services Tax. (2007 Article IV report, p.3)

Since the major part of tax incentives already took place in 2006, the fiscal stance of Canada in 2007 can be broadly described as neutral, and, therefore, receives score 0.

Canada 2008: 0

Despite the slowdown in the United States in 2008, the fiscal position of Canada remained sound and broadly neutral, and so received score 0. According to the 2008 Article IV report:

> In the Economic Statement, the government proposes to use this overperformance to finance tax relief (¼ percentage point of GDP) and a one-off additional debt reduction (½ percentage points of GDP). Next fiscal year, the overperformance would be used

> to finance the full annual cost of the tax relief measures, and the projected surplus remains around the debt reduction target.
>
> The mission agreed with officials that the comfortable projected fiscal position provides room for permanent tax relief. Indeed, given the worsening of the economic outlook, the fiscal stimulus in 2008 appears fortuitously timed. (p.19)
>
> A sound fiscal framework policy has produced an enviably strong fiscal position that makes eliminating general government net debt by 2021 feasible. (p.24)

Canada 2009: -3

According to the 2009 Article IV report (p.1),

> Canada entered the financial crisis on a solid footing, reflecting a strong macroeconomic framework, rigorous financial regulation, and robust corporate balance sheets. While it has avoided severe spillovers, international linkages are pressuring financial conditions and economic growth.

Therefore, the Canadian government designed a stimulus package which meant that the 11-year string of fiscal surpluses ended in 2009 and that caused a delay in the debt reduction target.

The fiscal support to the economy was one of the largest amongst OECD countries and included both allowing automatic stabilizers (more than 1% of GDP stimulus) to operate in full and a large discretionary package (1.8 % of GDP). This resulted in a score of -3 in 2009, meaning an extremely expansionary fiscal stance.

> Staff noted that the January 2009 fiscal package was appropriately large, timely, well diversified and structured for maximum effectiveness (with a large direct spending component and matching resources from the provinces on infrastructure), building on the permanent tax relief from the 2007 Fiscal and Economic Update. Notably, the January stimulus relies mainly on infrastructure spending, and support to vulnerable sectors (including housing) and provinces. It boosts safety nets, thus protecting the most vulnerable; provides training to facilitate job reallocation; and allows automatic stabilizers to be given full play. It also provides permanent tax relief, particularly to low- and middle-income households. Finally, the budget cuts external tariffs, in line with Canada's long-standing commitment to trade liberalization and openness. (2009 Article IV report, p.13)

Canada 2010: -3

Overall, strong fiscal expansion continued in 2010, with automatic stabilizers in full operation to support the economy and a discretionary fiscal package amounting to 1.6% of GDP, which implied the same fiscal stance score as in 2009. According to the 2010 Article IV report,

> The government has announced additional details on infrastructure funding, namely that it will extend by seven months the deadline for infrastructure projects to be completed under the economic stimulus, to October 31, 2011. (p.1)
>
> The mission praised the fiscal response to the crisis during 2009-10 and supported the authorities' medium-term plans under the budget. Staff noted that the March 2010 Budget was appropriately focused on balancing the budget over the medium term […]. It also followed through on the second year of Canada's Economic Action Plan as anticipated, building on the 2009 stimulus and earlier permanent tax relief. The 2010 stimulus package—which the authorities confirmed was on track and 98 percent committed by end September—included for FY 2010–11 a sizeable dose of infrastructure capital investments, tax relief, employment insurance (EI) and training measures, along with industry specific measures and support for research and development. (p.13)

Canada 2011: 1

According to the 2011 Article IV report:

> The authorities have appropriately shifted toward fiscal consolidation. The federal government is leading the initial fiscal effort, and regional governments are expected to follow suit. Canada has room to respond flexibly to changes in the economic outlook, including by allowing full operation of automatic fiscal stabilizers should the recovery falter. (p.1)
>
> Fiscal consolidation is now under way, as the policy stimulus is being gradually removed. The federal government, which recently updated its adjustment plans to reflect a worsening of the outlook, is leading the initial fiscal effort with a federal budget deficit reduction of some 1 percent of GDP in structural terms between 2010 and 2012, including by unwinding the stimulus measures. For provincial and local governments, staff expects a broadly stable deficit in 2011, on the basis of the outturn in the first half of the year and the extension of some stimulus measures, and some deficit reduction in 2012. Overall, staff projects a reduction in the general government structural deficit of around 0.3 percent of GDP in 2011 and 0.8 percent of GDP in 2012. (p.10)

In 2011, the authorities realize the need to gradually remove the stimulus and start to implement the consolidation measures mainly through expenditure restraint. In 2011, the year-to-year change in expenditures as a share of GDP on the Federal Government level amounted to about -0.7% and -0.6% on provincial-territorial-local level.

Overall, since the consolidation efforts in 2011 do not exceed 1% of GDP, the fiscal stance score is 1.

Canada 2012: 1

From the 2012 Article IV report (p.6):

> Fiscal consolidation continued in 2012, with the federal government leading the effort and most provinces proceeding with their consolidation plans. As a result, the contribution to growth from government consumption and public investment is expected to have turned negative in 2012, for the first time since 1997. The general government cyclically-adjusted fiscal deficit fell by a cumulative estimated 1¾ percentage points between 2010 and 2012, mainly reflecting cuts in spending.

In 2012, the year-to-year change in expenditures as a share of GDP amounted to about -0.5% on the Federal Government level and -0.4% on provincial-territorial-local level.

Overall, the consolidation measures in 2012 were tantamount to about 0.8% of GDP. According to the classification used in this paper, the fiscal stance in 2012 receives score 1.

Canada 2013: 1

Overall, the consolidation followed the trend established in 2011 and the fiscal stance received score 1. According to the 2013 Article IV report:

> The authorities noted that they were somewhat surprised at the better-than expected federal budget deficit for 2012–13, to the extent that it reflected departments spending less than the budget they had been appropriated at the beginning of the year. They attributed this result to efficiency gains achieved at the departmental level, which would suggest a relatively small drag on growth from fiscal restraint. (p.15)

> The federal authorities have recently announced the intention to introduce a rule requiring balancing the federal budget "during normal economic times," with a clear timetable for returning to a balanced position if falling into deficit. (p.17)

Canada 2014-2015: 1 and 0

According to the 2014 Article IV report (p.7):

> Public finances continued improving in 2014, reflecting federal and some provincial consolidation efforts. The federal government is essentially on track to achieving its balanced budget target in FY2015/16. This reflects better-than-expected revenue because of stronger-than-projected growth, one-off measures (including ¼ percent of GDP from an auction of broadband spectrum license), and lower spending ahead of planned restraint initiatives. Recently introduced income tax cuts and enhanced child care benefits, as well as lower oil prices that will affect nominal tax revenues, are not expected to materially delay reaching budgetary balance in FY2015/16.

Overall, both federal and provincial governments are focused on reducing their deficits. With all recovery stimulus removed, modest structural consolidation of about 0.5% of GDP still continues in 2014. In 2015, the fiscal stance could be described as neutral due to the effects of tax cuts and enhanced child-care benefits.

<u>Portugal</u>

Portugal 2006: 2

According to the 2006 Article IV report (p.3), the Portuguese economy is currently undergoing difficult times:

> A mild recovery is underway but the economic environment remains difficult. Several years of rapidly rising unit labor costs have substantially undermined competitiveness. Investment has collapsed, the unemployment rate has doubled, the 2005 fiscal deficit reached 6 percent of GDP, and the current account deficit has swollen to more than 9 percent of GDP. A lengthy period of adjustment will be required not only to restore external competitiveness but also to ensure the sustainability of public finances.

According to the 2006-2007 Stability Programme, the authorities plan to continue the gradual reduction of the nominal deficit ratio until it achieves a value below 3% of GDP in 2008; this reduction maintains exactly the same format as that previously established – a reduction of 1.4 p.p. in 2006, 0.9 p.p. in 2007 and 1.1 p.p. in 2008

> The 2006 budget plans a reduction in the deficit to 4.6 percent of GDP, implying just over 1½ percentage points of structural adjustment. The authorities were confident the deficit target would be achieved but committed to undertake additional measures if needed. A little more than half of this year's deficit reduction is to come from the full-year impact of revenue measures announced last year, in particular the VAT increase, with the balance coming mostly from savings in the public wage bill and intermediate consumption. (2006 Article IV report, p.15)

> Budgetary consolidation in 2006, which was essentially borne by measures to reduce primary expenditure, required very significant endeavour. Consolidation will remain focused on reducing expenditure in following years, with reductions generally exceeding 1 p.p. of GDP. Table 2 in the Appendix shows that all components of primary expenditure reduce their percentage of GDP, which primarily reflects not only the full impact of PRACE [SK: reorganization of public sector], but also, in relation to social benefits, the gradual increase of restraint brought about by the reforms to the (general and civil service) Social Security schemes. (2006-2007 Stability Programme, p.39)

Therefore, the fiscal score in 2006 is 2.

Portugal 2007-2008: both 1

According to the 2007-2008 Stability Programme (p.3):

> The budgetary consolidation effort that has been ongoing since 2005 is essentially based on structural measures to curb expenditure and reduce the weight of expenditure in GDP and improve the efficiency of the tax system, particularly by fighting tax evasion and fraud, as the basis for sustained growth in revenue. Budgetary policy has ensured that the objectives focused on correcting budgetary imbalance established in the December 2005 update of the SGP have been achieved. As a result, the structural deficit was reduced by 3.0 p.p. of GDP between 2005 and 2007 (2.3 p.p. in 2006 and 0.7 p.p. in 2007). In nominal terms, the consolidation effort that has been conducted to

> date should ensure that in 2007 Portugal does not exceed the 3% threshold for overall deficit, one year ahead of schedule.
>
> The structural balance is forecast to improve by 1.7 p.p. of GDP between 2007 and 2011, achieving approximately -½% of GDP in 2010 and sustaining this value in the following year. This target is concurrent with that established by the Portuguese Government in December 2005, as the medium-term objective, and its compliance requires sustained effort to ensure rigour in the budgetary consolidation process.

From the 2008-2009 Stability Programme (p.37):

> "The consolidation profile followed since 2005 has concentrated on expenditure, especially current primary expenditure, and on revenue, mainly through the impact of the improved voluntary compliance by taxpayers and the good results achieved in the fight against tax and contribution fraud and evasion […].
>
> In 2007 and 2008, the structural deficit fell to 0.9 p.p. and 0.5 p.p. of GDP, respectively. This evolution will be temporarily interrupted in 2009, due to the impact from the cyclical use of budgetary policy to combat the effects of the economic crisis and the action of automatic stabilisers".

Given a slight reduction of the consolidation rate, the fiscal score in 2007-2008 is 1.

Portugal 2009: -1

From the 2008-2009 Stability Programme (pp.35-36):

> In view of the exceptional circumstances existing in the current economic situation, marked by a heavy contraction of activity, and benefiting from the budgetary margin achieved by the budgetary consolidation process in the meantime, it was decided to strengthen the use of budgetary policy instruments to support investment and employment, considering the current economic climate. Thus, the Portuguese Government, in the context of the coordinated Europe-wide anti-cyclical effort, underlying the European Economic Recovery Plan, approved the Investment and Employment Initiative (IEI), which complemented the household and business support measures taken during 2008.
>
> The impact of these measures on the budgetary balance will be temporary, and are expected to be concentrated in 2009, when the budget deficit is forecast at 3.9% of GDP. The resumption of the budgetary consolidation trajectory should occur from 2010. The structural adjustment of 1.6 p.p. of GDP in 2010 and 2011 jointly is greater than that forecast in the last SGP update.
>
> Following a budgetary consolidation process that should result in 2008 in the lowest budget deficit of the last 30 years, exceptional economic circumstances require that the focus in 2009 is on a strong anticyclical budgetary effort to support investment and employment, the most vulnerable households and the strengthening of financial stability.

Measures taken during 2008 to combat the effects of the crisis amounted to only 0.4 percent of GDP. The direct impact of the measures under the Investment and Employment Initiative increased the deficit by 0.8 percent of GDP in 2009, indicating a moderate fiscal expansion and a fiscal score of -1. Main measures included the modernisation of schools, fostering renewable energies and energy efficiency, the modernisation of the technological infrastructure and measures to support economic conditions and employment.

Portugal 2010-2011: 1 and 2

Portugal started the consolidation process relatively early, with the structural adjustment in 2010 estimated to be 1.2 percent of GDP. From the 2009-2010 Stability Programme (pp.1-2):

> It should be emphasized that given the prevailing domestic and international economic environment and the uncertainties that still exist, the recently approved State Budget for 2010 already envisages a reduction of the General Government deficit to 8.3% of GDP this year. Thus, the Portuguese Government decided to initiate the process of reducing the General Government deficit this year, and intensify that reduction in subsequent years by a further 5.5 p.p., in order to achieve the aforementioned target of 2.8% of GDP in 2013.
>
> In line with what the Portuguese Government has shown being capable of, since 2005 and until the onset of the international crisis, the adopted fiscal consolidation strategy is primarily based on cutting public and tax expenditure, and on the additional correction of the growth of public debt through a broad privatisation program, opting to maintain a general framework of stability for tax structure and favouring the recovery of economic activity.
>
> In the following years (2011 to 2013), the General Government deficit will need to be reduced by 5.5 percentage points (p.p.) in order to achieve the goal of 2.8% of GDP in 2013. In terms of structural balance, a 1 p.p. reduction is achieved in 2010 and a reduction of 5 p.p. in 2011 to 2013.

A detailed description of measures under the consolidation programme, in particular in social expenditure as well as measures in tax system, can be found in the 2009-2010 Stability Programme […].

The consolidation programme provides for a modest tightening in 2010 followed by more significant efforts in the following years. Therefore, the fiscal score is 1 in 2010 and 2 in 2011.

Portugal 2012-2014: 2 in 2012-2013 and 1 in 2014

From the 2012 Stability Programme (p.5, of the Portuguese language version, translated by the author):

> The program sets quantitative targets through binding limits on the budget deficit and on public debt from 2011 to 2013. In terms of budget deficits as a percentage of GDP, objectives are 5.9% for 2011, 4.5% for 2012 and 3.0% in 2013. Public debt is expected to reach a peak in 2013, as a percentage of GDP, starting from there on a

> downward trajectory. There are also indicative criteria for the non-accumulation of arrears, both internally and external. It should be noted that in a medium-term context and in view of international commitments undertaken, Portugal must present a structural deficit not exceeding 0.5% of GDP from 2015.
>
> The adoption of the demanding fiscal consolidation measures contributed to the substantial improvement in the structural balance, with an impact initially estimated at 5.7 ppt contrasted against a scenario of invariant policies.
>
> However, following the deviations of budget execution identified in mid-2011 in part caused by a set of temporary nature factors, the Government has taken steps. Among them are the introduction of a special surcharge on personal income tax and anticipation of the revision in the rate of VAT for energy goods to the normal rate.

The deviation from the consolidation programme targets was mostly caused by the macroeconomic instability in the Euro Area. However, these changes can be considered as cyclical, while the underlying structural stance remained as planned. Therefore, the fiscal score remained at 2 in 2012-2013. In 2014, due to the successes of previous years the fiscal consolidation effort was about 0.7 percent of GDP, which implies a fiscal score of 1.

Portugal 2015: 1

From the 2015 Article IV report (p.14):

> Fiscal policy should be guided foremost by sustainability considerations. Despite the notable consolidation achieved to date, Portugal remains vulnerable to shifts in market sentiment due to its high stock of public debt (the third-highest in the euro area following Greece and Italy), large refinancing needs, small size of the economy, and weak growth prospects.
>
> There will be a slight relaxation of the fiscal stance in 2015. Staff projects a fiscal deficit of 3.2 percent of GDP for 2015—marginally above the excessive deficit procedure target of 3 percent of GDP—and higher than the budgeted 2.7 percent of GDP. The difference relative to the budget target primarily reflects more pessimistic revenue assumptions, as the budget incorporates large revenue gains from a range of measures to improve tax compliance and recover outstanding tax debt. As a result, the structural primary balance is projected to deteriorate.
>
> Going forward, fiscal policy should be anchored around an annual structural primary adjustment of 0.5 percent of GDP.

Overall, the consolidation programme proved to be successful in reducing the deficit and long-term fiscal outlook. The consolidation proceeded but at a very moderate rate of about 0.2 percent of GDP. Therefore the fiscal score in 2015 is 1.

France

France 2006: 1

The French economy has experienced an economic upturn since the spring of 2005 and economic growth is expected to exceed 2 percent in 2006. However, the authorities remain concerned with the debt-to-GDP ratio which is above 75 percent, and in the Stability Programme they presented a multi-year debt-reduction plan underpinned by three pillars: increased efforts to rationalise public spending, efforts to boost potential growth, and divestment of non-strategic assets. In line with European Commission recommendations, in 2006 France reduced its structural deficit by 0.5 percentage point of GDP. Therefore, the fiscal stance score of France in 2006 is 1.

France 2007: 0

The French authorities continue moderate fiscal consolidation with the aim of reducing the debt-to-GDP ratio. From the 2006 Article IV report (pp.3-4):

> The draft 2007 budget aims to reduce the deficit from 2.7 percent to 2.5 percent of GDP while lowering the tax burden. With growth assumed to be 2¼ percent, this is to be accomplished as follows:
>
> On the expenditure side, general government spending is set to grow by 1.4 percent in real terms, for a 0.4 percent decline in the expenditure-to-GDP ratio. Central government expenditure is planned to fall by 1 percent in volume terms after three consecutive years of zero real growth. The number of civil servants will decline by 15,000 (in full-time equivalents). Nominal social security spending growth is projected to stabilize at about 3¼ percent, anchored by a health care spending norm of 2.5 percent. However, pension payments will rise as an increasing number of baby boomers are retiring. Local government expenditures are expected to continue growing above nominal GDP, reflecting strong investment and a rising wage bill.
>
> Revenues from taxes and social security contributions are projected to fall by 0.3 percentage point to 43.7 percent of GDP. Two thirds of this decline stem from a preannounced income tax reform, which reduces the number of brackets and the highest marginal rates.

Although the authorities estimate a structural adjustment of 0.4 percent of GDP, IMF staff on the basis of upward-revised estimates of potential growth argue that the fiscal stance in 2007 is neutral. As argued in the 2009 OECD Economic Surveys (p.28):

> A number of measures adopted in 2006 had the effect of reducing combined personal and corporate income tax revenues by some 0.6-0.8% of GDP in 2007. Those measures included reducing the number of tax brackets for households (from 7 to 5), along with lower rates, a more generous PPE (earned-income tax credit), and an enriched research tax credit for corporations. Further income tax cuts were voted in August 2007 with adoption of the TEPA (Work, Employment and Purchasing Power Act).

Therefore, in the classification the fiscal stance is given score 0 as broadly neutral.

France 2008: 0

According to the 2009 Article IV report (pp.6-7):

> The fiscal stance eased in 2008 and the fiscal deficit exceeded the Maastricht ceiling. The general government deficit increased from 2.7 percent in 2007 to 3.4 percent of GDP in 2008, triggering a reopening of the European Commission excessive deficit procedure (EDP). While primary expenditures were kept in check, revenues were affected by the worsening economic situation and by tax cuts granted under the law on work, employment, and purchasing power (Loi de Travail, Emploi et Pouvoir d'Achat, TEPA). Although the TEPA law provides incentives to work more, it also entails sizable annual budgetary costs (0.3-0.5 percent of GDP in 2008).

However, in the Stability Programme 2008-2009 the authorities argue that the worsening of the public balance overshadowed the structural effort, saying that the structural balance actually improved by 0.3 percent in 2008. Given all the evidence, France's fiscal stance in 2008 receives score 0 as broadly neutral.

France 2009-2010: -2 and 0

As described in the 2009 Article IV report Statement by Executive Board (p.1 of the Statement):

> The global financial crisis and the contraction of world trade have pulled the French economy into a severe recession and put its financial sector under strain. Structural features combined with early policy action have helped soften the downturn, which is somewhat less pronounced than in the euro area as a whole. Nonetheless, unemployment has risen steeply since mid-2008, while consumer price inflation has come down rapidly.

According to the Stability Programme 2009-2010 (p.2):

> The French Economic Recovery Plan launched in 2009, was timely, targeted and temporary, and consistent with the European Economic Recovery Plan framework. France's plan emphasised support for investment, and contained measures for supporting the purchasing power of those households that were hardest-hit by the crisis.

According to Stability Programme 2008-2009 (p.7),

> The recovery plan has a total budget of 26 bn. euro, i.e. 1.3 points of GDP, divided as follows:
> - €11.6 bn in cash to remove borrowing constraints for businesses, particularly by speedingup repayment of business claims on the State;
> - €10.5 bn in public investment, divided between the State (€4 bn), public enterprises (€4 bn)
> and the local authorities, which will be supported for this purpose by the State (€2.5 bn);
> - €2 bn for the sectors most exposed to the crisis: housing and the automotive industry;
> - €2 bn for measures to support employment and the income of the poorest households.

Therefore, due to a sizeable stimulus programme, the fiscal stance score in 2009 is -2. Most of the measures under the French Economic Recovery Plan were implemented before 2010. According to the Stability Programme 2009-2010 (p.2 and p.8):

> The recovery is still fragile, and a few recovery measures from 2009 will be carried over into 2010, on an adapted and strictly temporary basis. Beyond 2010, the French government will considerably strengthen its efforts to consolidate public finances. (p.2)
>
> The structural balance would be stable in 2010. Yet, this stability includes temporary deterioration factors connected to the suppression of the local business tax, as well as new factors involving support for economic growth: future-oriented investments. Without these two elements, structural balance would be up by 1/2 point of GDP for 2010. (p.8)

Therefore, the neutral fiscal stance of France in 2010 was described by the score 0 in our classification.

France 2011-2012: both 2

Although the fiscal stimulus during the crisis was appropriate but debt sustainability and market perception now call for credible consolidation. The impact of the crisis weakened France's fiscal position, bringing the debt burden to above 80 percent of GDP, and debt servicing costs to about 2½ percent of GDP in 2010.

Therefore, a deep consolidation was set in motion. As set out in the Stability Programme 2009-2010 (p.8):

> Starting in 2011, the structural adjustment would be more pronounced, due to the combined effect of government-wide efforts to contain public expenditures and, to a lesser extent, a reduction in tax expenditures and social contribution exemptions. Moreover, after their negative overshooting during the crisis, tax and social security contributions – and tax revenues in particular – should progressively return to normal, slightly outpacing GDP in the medium term.
>
> In all, the structural balance should improve by an average of approximately 1.4 points per year for the period 2011–2013. For 2011, the above-mentioned effects will be complemented by the disappearance of two temporary factors that will have contributed to the degradation of the balance in 2010.

According to the 2013 Article IV report (p.5):

> Strong fiscal adjustment in 2012 resulted in a structural budget improvement of 1.1 percent of GDP, which came on top of a similar effort in 2011. However, because of a widening cyclical component, the 2012 deficit declined by only ½ a percent of GDP relative to 2011. At 4.8 percent of GDP, the 2012 fiscal deficit exceeded the level projected in the last staff report by 0.3 percent of GDP owing to lower-than-projected growth and exceptional factors (including recapitalization of Dexia).

Given the decisive consolidation efforts in 2011-2012, the fiscal stance is described by score 2 in the classification.

France 2013: 2

The authorities are embarked on a path of rapid fiscal consolidation, reflecting euro area commitments and the need to enhance market confidence.

According to the 2013 Article IV report (p.5):

> With a view to closing the gap relative to the EC's Excessive Deficit Procedure (EDP), the pace of adjustment was accelerated further under the 2013 budget, with a targeted structural adjustment of 1.8 percent of GDP. Tax measures are expected to contribute 1.4 percentage points of this adjustment, with the rest coming from a reduction of structural spending in relation to GDP. In all, the rapid fiscal consolidation of 2011–13 has relied heavily on revenue measures, with a projected increase in the tax-to-GDP ratio of 3.7 percentage points over 3 years. Over the same period, expenditure growth was also reduced considerably (to an annual real growth averaging 0.6 against trend growth estimated at 1.5 percent), but the ratio of structural spending to potential GDP has declined by only 0.3 percentage points.

Due to large consolidation continuing, the fiscal stance score remains 2.

France 2014: 1

In 2014, the government deficit shrank by 0.1 percentage points of GDP, from 4.1% to 4.0%, but this small change in nominal terms obscures a greater structural effort.

From the 2013 Article IV report (p.21):

> Under the Stability Program of April 2013, structural adjustment would remain substantial in 2014, with a proposed 70 percent contribution from expenditure containment and 30 percent from revenue measures. Adjustment would moderate thereafter until a small structural surplus is reached in 2016.
>
> Thus, whereas the Stability Program estimates structural fiscal adjustment to be 1 percent of GDP in 2014, the same underlying effort produces a structural adjustment of 0.8 when using the staff's macroeconomic framework.

France had started out with an already higher tax burden than most of its peers in 2011 and most of the consolidation in previous years had come through revenue measures, but starting from 2014 most of the measures are on the expenditure side. The size of adjustment was within 1 percent of GDP in 2014, which means that the fiscal stance score is 1.

France 2015: 1

From the 2015 Stability Programme (p.19):

> In 2015, the improvement of the government balance by 0.2 percentage points of GDP will once again rely on a major expenditure effort worth 0.8 percentage points of GDP, with nominal government expenditure growth of 0.9%. This effort will be based

> on savings measures passed in the Initial Budget Act, along with €4 billion in additional measures, which are primarily expenditure measures, as explained in this Stability Programme […], to offset the impact of lower-than-expected inflation on government accounts. Revenue measures will be neutral in aggregate. Despite the negative impact of tax elasticity (-0.2 points) stemming from low inflation, which slows the natural growth of the tax base, and the persistently negative contribution of the correction for accrual-based measurement of tax credits (-0.1 points), France will still deliver an improvement in the structural balance of 0.5 percentage points of GDP.

Overall, the consolidation was similar in size and nature to 2014, which is the reason why the fiscal score stays the same.

Ireland

Ireland 2006:-1

From the 2006 Article IV report (p.11):

> The general government fiscal position has been either close to balance or in surplus for the past decade. Combined with rapid economic growth, this has led to a sharp decline in the government debt ratio.

In 2006, the authorities projected the real GDP growth of Irish economy to be equal to 4.8 percent and cyclically adjusted balance to show a surplus of -0.2 percent of GDP. However, according to the 2005-2006 Stability Programme, the change in CAPB was expected to be around -0.6 percent GDP.

Despite the IMF recommendation that Ireland should implement some consolidation, the authorities remain growth-oriented. Therefore, the fiscal score of Ireland in 2006 is set to -1.

Ireland 2007: -1

From the 2006 Article IV report (p.12):

> For 2007, staff called for modest fiscal tightening, in contrast to the substantial loosening implicit in the authorities' projection. Given the likely outcome for 2006, staff observed that the 2006 Budget projection for 2007 would imply fiscal stimulus of more than 1 percentage point of GDP. Staff suggested that fiscal tightening of ½ percentage point of GDP (implying a surplus of 1 percent of GDP in 2007) would be desirable in light of short-, medium-, and long-term considerations.
>
> There is a consensus among international economic forecasting institutions that, notwithstanding the current slowdown in the US economy, the short-term outlook for the global economy is generally positive. […]
>
> The projected budgetary position over the period 2007 – 2009 is for a General Government budget surplus of 1.2% of GDP in 2007 followed by surpluses of 0.9% in 2008 and 0.6% in 2009. The cyclically-adjusted budget balance, with a surplus of 1.8% of GDP in 2007 followed by surpluses of 1.7% in 2008 and 1.5% in 2009, respects the terms of the Stability and Growth Pact, and is consistent with a medium-

> term objective of keeping the budget close to balance. The debt-to-GDP ratio will be maintained at the second-lowest in the euro area, declining to around 22% over the forecast period. The market value of the assets of the National Pensions Reserve Fund is estimated to be in the region of 10% of GDP at the end of 2006. (2007 Stability Programme, p. 5)

Due to the fiscal stimulus amounting to about 1 percent of GDP, the fiscal score was not changed and remained -1.

Ireland 2008: 0

From the 2007-2008 Stability Programme (pp.5-6):

> The prospects are for a moderation in the growth rate of the Irish economy, partly reflecting lower levels of new housing output in the short-term. An average GDP growth rate of 3.5% per annum over the period 2008 – 2010 is currently projected.
>
> The projected budgetary position over the period 2008 – 2010 is for a General Government budget deficit of -0.9% of GDP in 2008 followed by deficits of -1.1% in 2009 and -1.0% in 2010. In terms of the cyclically-adjusted budget balance (CABB) a small deficit of -0.3% of GDP is projected in 2008. The cyclically adjusted position points to deficits of -0.4% in 2009 and -0.6% in 2010. However, if the contingency provision is excluded the cyclically adjusted position shows a balanced position in 2009 and a modest surplus in 2010. The programme respects the terms of the Stability and Growth Pact, and is consistent with a medium-term objective of keeping the budget close to balance. It is therefore compliant with the medium-term objective as outlined in Council regulation 1055/2005 amending regulation 1466/1997. The debt-to-GDP ratio will be maintained at one of the lowest in the euro area, averaging around 27.4% over the forecast period. The market value of the assets of the National Pensions Reserve Fund was in the region of 11% of GDP at the end of September 2007.

Overall, in 2008, the authorities realize that the position of the public finances can be put at risk if further deficits are allowed. Therefore, they did not implement discretionary stimulus to support the slowing economy, instead they stayed roughly neutral. Therefore, the fiscal score changes to 0.

Ireland 2009-2011: 3

According to the 2009 Article IV report:

> Given its serious internal imbalances, Ireland was especially vulnerable to the recent global shocks. Overextension in construction and financial intermediation, along with loss of international competitiveness, has meant that the impact will be sizeable. Cumulatively, GDP is projected to contract by 13½ percent through 2010, the largest among advanced economies. (p.1)
>
> Well before the crisis hit, public finances had developed serious structural weaknesses. The facts are well known. In the boom years, personal income tax rates

were lowered and expenditure grew rapidly (at about the highest pace among OECD economies). Buoyant property-related revenues (stamp duties, VAT, and capital-related taxes) masked the growing structural deficit, which reached 12½ percent of GDP in 2008 […]. (p.21)

In 2007, when the headline budget was in balance, the staff's estimate is that adjusting for the large positive output gap and the effect of the asset price bubble, the structural deficit was about 8¾ percent of GDP. (p.22)

The authorities realized the need for urgent consolidation measures. From 2009 OECD Economic Surveys:

Additional policy measures were taken in July 2008 to reduce spending. The Budget for 2009 was then brought forward to October 2008 to raise almost € 2 billion in a full year (1% of GDP) in additional taxation. An income levy was introduced and new taxes imposed on items such as second homes, airline passengers and car parking. The VAT rate was increased by 0.5 percentage points. As the scale of the revenue collapse emerged, further rounds of austerity measures were introduced:

- In February 2009, budget savings of € 2 billion in a full year were announced, including the introduction of the Pension Levy, a pension-related pay deduction averaging 7% for public servants. Postponing the next rounds of the national pay agreement secured savings of up to € 1 billion relative to the 2010 baseline.

- The Supplementary Budget in early April 2009 introduced measures to claw back a further € 5 billion (3% of GDP) full-year slippage in the budget deficit compared to that projected in January. (pp.50-51)

The discretionary action already taken so far amounts to a cumulative budget consolidation of around 5% of GDP by 2010. This stands out internationally as a response to the recession as most other OECD countries have undertaken discretionary fiscal stimulus packages, albeit on a small scale in many cases […]. However, the discretionary fiscal tightening is smaller than the overall increase in the budget deficit, consolidation measures of close to € 5 billion have been set out for each year of 2010 and 2011, equivalent to nearly 3% of annual GDP. (p.52)

Overall, according to 2011 OECD Economic Survey the consolidation measures implemented and planned in 2008-2010 amounted to 9.3 percent of GDP, which means a sustained effort of more than 3 percent annually. Additionally, planned consolidation in 2011 amounted to 3.8 percent of GDP.

Therefore, the fiscal score is set to 3 in 2009-2011.

Ireland 2012: 3

From the 2012 Medium Term Fiscal Statement:

It is clear that significant challenges remain for Ireland. The large gap that still exists between Government spending and revenue must be closed. Continuing to run big

> deficits and engaging in the large volume of borrowing required to fund them is simply not viable. To do so would result in an unsustainable stock of debt and long-term loss of sovereignty. (p.11)
>
> In any event, our international obligations under the EU/IMF Programme of Financial Support entered into in late 2010, and under the Stability and Growth Pact, require us to make measurable progress in reducing the budget deficit. Under the latter we must cut the deficit to less than 3% of GDP by 2015. It is currently estimated that to do so will necessitate adjustment measures amounting to a total of €12.4 billion over the 4-year period 2012-2015, the implementation of which is projected to arrest the rise in the debt/GDP ratio and bring about a 5 percentage point reduction between 2013 and 2015. (p.4)

From the 2012 Stability Programme:

> The 2012 Budget implemented a substantial budgetary adjustment package aimed at further improving the public finances with a GGB of –8.6% of GDP targeted for this year, consistent with the limit set in December 2010. (p.19)
>
> The main revenue raising measure introduced in the 2012 Budget was a 2% increase in the standard rate of VAT, and March was the first month in which the full impact of the rate change was evident. On a cumulative basis, VAT was €101 million or 3.2% ahead of target at the end of the first quarter, and €182 million or 5.8% up on the same period in 2011. (p.21)

Overall, according to the 2011 Article IV report, the consolidation effort in 2012 was projected to be 2.7 percent of GDP. The fiscal score was not changed and remained at 3, indicating a continuing large-scale fiscal consolidation.

Ireland 2013: 3

From the 2013 Medium Term Fiscal Statement (pp.11-12):

> Ireland has been engaging in a fiscal consolidation strategy since mid-2008. The process started because of the widespread recognition internally that the public finances were deteriorating very rapidly, so Ireland was “ahead of the curve” in that respect.
>
> Expenditure reducing and revenue raising measures designed to save/yield approximately €25 billion (around 16% of 2011 GDP) have been implemented to date. This is a very significant level of consolidation by any measure.
>
> Notwithstanding the progress made, it is clear that there remains a very large gap between revenues and expenditure. This year that gap, in General Government expenditure and revenues terms is estimated to be €13.5 billion or 8.3% of GDP. This is likely to be one of, if not, the highest deficit in the EU. Given that a still significant level of further fiscal adjustment is required to reduce the deficit below 3% of GDP by 2015, a combination of both revenue raising and expenditure reducing measures must be implemented.

According to the 2013 Summary of Budget Measures, the total consolidation planned for 2013 amounted to 3.5 percent of GDP. Out of that 2.25 percent was expenditure based, including a 1.7 percent cut in current expenditure and a 0.55 percent cut in capital expenditure. Revenue measures were expected to save 1.25 percent of GDP. The fiscal score was not changed and remained at 3, indicating one of the largest and most prolonged consolidation programmes in the OECD countries.

Ireland 2014: 2

According to the 2014 Stability Programme (p.13):

> The 2014 Budget forecast tax revenue to increase by close to 6 per cent year-on-year in 2014. Performance through the first quarter 2014 has been positive with taxes ahead of profile by €257 million (2.9 per cent) which represents a year-on-year increase of €415 million (4.7 per cent). Looking at the individual tax heads, of particular note is the strong performance of income tax, the largest tax head, on the back of a recovering labour market.
>
> Turning to the spending side, the Revised Estimates for Public Services 2014 (REV), which was published in December 2013, set out the detailed allocations for all Government Departments. The 2014 estimate for total gross voted expenditure is €53 billion. This is 2.7 per cent below the 2013 provisional outturn figure. Net voted expenditure for 2014 at €41.4 billion is 4 per cent lower than in 2013. Expenditure by all Departments will continue to be monitored closely against their detailed monthly gross and net profiles.

Moving from the 2013 general government deficit of 7.2 percent to the budgeted deficit of 4.8 percent, about 0.7 percent is due to revenue measures and about 1 percent are expenditure savings. The rest of the improvement is either temporary (end of the eligible liabilities guarantee (ELG) scheme) or cyclical. Therefore, the structural consolidation effort in 2014 amounted to 1.7 and the fiscal score is changed to 2 in 2014.

Ireland 2015

From the 2015 Stability Programme (p.11):

> The fiscal outlook for 2015 remains broadly unchanged from that set out in 2014 Budget, with the Government committed to introducing the necessary tax and expenditure measures to bring the deficit below the 3 per cent of GDP deficit target by the end of 2015, as set out in the Excessive Deficit Procedure.
>
> 2015 Budget targeted a deficit of 2.7 per cent of GDP in 2015, well inside the 3 per cent of GDP deficit limit. Developments in the intervening period have been primarily positive and the deficit is now forecast to be in the region of 2.3 per cent of GDP.

In transition from the 2014 general government deficit of 4.1 percent to the budgeted deficit of 2.3 percent, about 1.1 percent is due to revenue measures and about 0.2 percent is expenditure savings. The rest of the deficit reduction is either temporary or cyclical.

Therefore, the structural consolidation effort in 2014 amounted to 1.3 and the fiscal score remained at 2 in 2015.

Sweden

Sweden 2006-2007: both -1

From the 2005-2006 Convergence Programme:

Between 2000 and 2002, the first three stages of a four-stage reform of income tax were implemented for households. In 2005, half of the fourth stage was implemented, and for 2006 the government proposes that the second half of the fourth stage be implemented, which equivalent to a tax is cut of some SEK 7 billion, or 0.3 per cent of GDP. (p.5)

Fiscal policy this year could thus be characterised as neutral despite the fact that the discretionary fiscal policy is strongly expansionary. The expansionary budget policy this year will also be offset by the improved net lending of local government. This is in addition to reduced sick leave, which in turn reduces transfer expenditure. […] (p.18)

From the 2006 Article IV report (p.6):

> Fiscal policy is strongly pro-cyclical in 2006–07. The structural surplus is likely to fall below the 2 percent target in 2006, as buoyant tax revenues are offset by pre-election spending on job-creation programs by the previous government. The tax cuts in the budget for 2007, including those in income, wealth and property taxes, amount to around 2 percent of GDP and would be financed partially by lowering welfare benefits, raising unemployment insurance contributions, and reducing spending on labor market programs. However, the net fiscal impact is expansionary, with the structural surplus projected to weaken substantially in 2006–07.

Although, the authorities describe the fiscal stance in 2006-2007 as neutral, in the classification Sweden receives a score of -1. This is because the tightening effect of automatic stabilizers (0.5 ppt of GDP in 2006 and 0.2 in 2007 ppt of GDP) did not fully offset the discretionary stimulus (1 ppt of GDP in 2006 and 0.9 ppt in 2007).

Sweden 2008: 0

From the 2008 Article IV report (p.27):

> The 2008 Fiscal Policy Bill aims the surplus at 2.9 percent of GDP, with further strengthening through 2011 on current policies. Its centerpiece is a SEK11 billion expansion in the earned income tax deduction. Together with other measures, tax cuts are 0.6 percent of GDP. These are offset by lower disability and other entitlement outlays—so that the structural surplus is little changed in 2008. On current policies, including these reforms and subindexing of some allocations, the authorities project a fiscal surplus of 4 percent of GDP by 2011.

In 2008, the fiscal stance was neutral, due to the fact that the fiscal stimulus was offset by tightening measures. Therefore, the fiscal score is 0.

Sweden 2009: -2

From the 2009 Article IV report:

> Sweden entered the downturn in robust fiscal health. Debt was low and falling, the framework of rules guiding policy has been consistently adhered to and the authorities have reiterated their commitment to it even in the context of the ongoing global shock. (p.30)
>
> With automatic stabilizers at full play together with fiscal measures, Sweden is providing large fiscal stimulus to the economy—6.6 percentage points of GDP in 2009, on staff estimates, one of the largest in the EU. However, even on the authorities' more optimistic assumptions, the fiscal swings from a surplus of 2.5 percent of GDP in 2008 to a deficit of 2.75 percent of GDP in 2009. […]
>
> With a relatively high tax burden to finance the generous welfare system, public finances in Sweden are comparatively sensitive to cyclical fluctuations and labor market developments. The Spring Bill projects a sizeable widening of the output gap in 2009 (to 7.2 percent). In this context, the full operation of the automatic stabilizers accounts for more than half of the deterioration in general government finances.
>
> In addition, discretionary fiscal measures are being implemented, amounting to 1.6 percent of GDP. These are mostly on the tax side, including permanent cuts in personal, social contributions and corporate income tax, amounting to 1 percent of GDP. (pp.31-32)

Due to one of the largest automatic stabilizers in the EU and a large discretionary package, the fiscal score of Sweden in 2009 is -2.

Sweden 2010-2011: both 0

From the 2011 Article IV report:

> Sweden grew 5½ percent in 2010, a leader among advanced economies. Real GDP growth rose at a fast clip from mid-2009, exceeding recoveries elsewhere among advanced economies […]. In part this was because the downturn had been cushioned by the krona's sharp depreciation—from levels that were already somewhat undervalued— boosting exports once global demand began to recover. At the same time, consumption was supported by monetary and fiscal stimulus. (p.3)
>
> In the absence of new initiatives, the structural balance strengthens automatically, in part due to fiscal drag and the non-indexation of key expenditures, as reflected in the authorities' projections. This creates space for new measures, consistent with staff advice to maintain the structural fiscal balance. Rather than using this available fiscal space for planned tax reductions in 2011, the authorities have maintained an extra fiscal buffer in view of remaining domestic and external macroeconomic uncertainties. (p.13)

From the 2010 Article IV report (p.22):

> With nominal monetary policy rates close to effective floors, and fiscal balance outturns in 2009 significantly stronger than planned, growth has resumed but the output gap remains large. So a further 2.3 percentage points of GDP of stimulus is planned for 2010—2.0 percentage points of which comprise new measures outlined in the Fall 2009 and Spring Bills 2010—and a further 1.6 percentage points of GDP of discretionary stimulus is planned for 2011. The recently announced nominal expenditure ceilings rise by SEK 10 billion in both 2013 and 2014 (1 percent) from the lowered 2012 ceiling, accommodating some resumption of public spending growth as economic growth normalizes.

From the 2011 Convergence Programme (p.12):

> In 2011, temporary support to municipalities will be phased out and the public finances will be strengthened somewhat, despite a reduction in taxes. Over the ensuing three years, finances will strengthen by SEK 21.8 billion, mainly as a consequence of temporary ventures on the expenditure side being concluded or scaled back. Expenditures in the central government budget, adjusted to agree, in accounting terms, with net lending, will, as a consequence of decisions, decrease by SEK 9.9 billion in 2011 in relation to the immediately preceding year.

Overall, according to the 2011 Convergence Programme, the additional discretionary stimulus measures in 2010-2011 roughly outweighed the effect of phasing out some temporary support measures. Therefore, the fiscal score in both years is 0, describing a broadly neutral stance.

Sweden 2012: -1

From the 2012 Article IV report:

> Sweden's recovery from the global crisis has been spectacular but underlying growth has now slowed sharply, unemployment remains above pre-crisis levels and the outlook is clouded given weaknesses in European trading partners. (p.1)
>
> Given that output is close to potential, strong sovereign access to markets, alongside downside external risks and the modest deviation of the fiscal balance from its structural surplus target, the appropriate setting for 2012 would be a mildly supportive stance anticipating a phased return to the structural surplus target thereafter. Along this trajectory, automatic stabilizers would operate in case of moderately weaker/stronger than anticipated activity, with scope to reset the structural fiscal trajectory as well if the global economy deviates markedly from projections. […]
>
> This fiscal trajectory is planned by the authorities. For 2012, as a result of the deceleration of growth and new discretionary measures being introduced as part of the 2012 Budget Bill, the budget balance is expected to remain at -0.3 percent of GDP in 2012. Revenues would remain subdued in line with weak employment and consumption trends. Expenditures would rise modestly, driven mainly by higher social benefits. The structural balance would on the authorities' estimates fall to 1.2

> percent of GDP implying a stimulus of 0.2 percent of GDP. Based on staff estimates, the structural balance falls to -0.3 percent of potential GDP, implying a stimulus of 0.5 percent of potential GDP. The difference between staff and authorities' estimates reflects different output gap estimates and different methodologies to calculate the structural balance. The main expansionary measures for 2012 are a lowering of the VAT rate for restaurant and catering services, extra funding for infrastructure investment and a package of active labor market measures …]. Spending will continue to be reined in part due to the non-indexation of key expenditures, a further phasing out of temporary stimulus measures, a decline in unemployment expenditure as the economic recovery takes hold, and the effects of previous reforms (such as reforms of the sickness insurance system). (pp.13-14)

During the years of strong recovery, the authorities have built up significant fiscal buffers. In 2012, due to Eurozone debt problems, the Swedish economy, which was heavily reliant on the financial sector, experienced some slowdown. The authorities responded by allowing some discretionary stimulus to increase the economy's competitiveness. Therefore, the fiscal score is -1, as mildly expansionary.

Sweden 2013: -1

From the 2013 Article IV report:

> After leading much of Europe in the recovery from the crisis, Sweden's economy is slowing together with its main Nordic and European trading partners. The outlook is for a sluggish return to moderate growth, but there are sizable downside risks compounded by financial fragilities. Notwithstanding ambitious financial reforms, Sweden's large banking system remains a potential vulnerability, and household debt is high and still rising. (p.1)

> Fiscal policy further supported growth. Fiscal policy reacted to counter the deteriorating outlook, with the structural balance dropping from -0.8 percent of GDP in 2012 to -1.4 percent of GDP in 2013, with automatic stabilizers fully at work. The 2013 Budget Bill added another slight expansion, including from a large corporate tax cut as well as infrastructure investment and labor market measures to tackle youth unemployment. At 38 percent of GDP at end-2012, public debt remains low […]. (p.6)

Therefore, the fiscal score remained -1 in 2013, describing a moderately expansionary stance.

Sweden 2014-2015: -1 and 1

From the 2014 Article IV report:

> Sweden's economy has re-gained speed, following supportive macroeconomic policies and strong household demand. Employment has been rising, but the labor force expanded even more, resulting in higher unemployment mostly among vulnerable groups. Inflation remains very low, driven by external and domestic factors. At the same time, financial stability risks are an increasing concern, reflecting

> high and rising household debt, accelerating house prices, and Sweden's very large banking system. (p.1)
>
> Fiscal policy remains expansionary for now. Net lending is projected to increase to -1.9 percent of GDP in 2014, up from -1.3 percent in 2013, primarily on account of lower revenues. Given strengthening growth, this implies—at least in hindsight—a procyclical structural expansion of about ½ percent of potential GDP. (p.6)
>
> Underpinned by the "krona-for- krona" strategy, which requires any reforms to be (at least) counterfinanced, the government has suggested a structural consolidation path with annual adjustments of about 1⁄2 percent of potential GDP starting in 2015. On staff's numbers, this would help achieve a headline fiscal surplus of above 1 percent of GDP by 2018 and reduce the public debt-to-GDP ratio to around 30 percent of GDP, from nearly 42 percent currently. The Swedish fiscal framework requires a 1 percent surplus "over the cycle," a target chosen to build up sizable fiscal buffers. While the length of a "cycle" is open to interpretation, under most definitions the target will not be met until later. (p.14)

Broadly speaking, the fiscal stance in 2014 remained moderately expansionary as in 2012-2013. According to the 2015 Convergence Programme the discretionary tightening in 2015 amounted to 0.3 percent of GDP and about the same amount came from automatic stabilization mechanisms, which resulted in an annual consolidation of about 0.5 percent GDP. Therefore, the fiscal scores are: -1 in 2014 and 1 in 2015.

Switzerland

Switzerland 2006: 1

As argued in the 2006 OECD Economic Surveys, while moderate by international standards, the deficit in Switzerland widened from 2000 to 1.25 percent of GDP in 2003/2004. As the authorities viewed the deterioration as partly structural, particularly at the federal level, they developed a consolidation strategy to eliminate the structural deficit estimated at ¾ percent in 2003. Therefore, in 2003 it was decided to adopt a "debt containment rule" (or "debt brake"), as a measure to eliminate structural deficits.

> Since 2003, the rule would have required that the federal accounts be kept permanently in balance by means of an expenditure capping mechanism. However, in view of the impossibility of applying this rule to the letter without running the risk of penalising activity, the authorities decided to raise the spending ceiling between 2004 and 2006, so as to initially stabilise the federal structural deficit at its 2003 level (¾ per cent of GDP) and then gradually eliminate it between 2005 and 2007, the aim being to apply debt containment thereafter. Parliament adopted a consolidation programme (1.1% of GDP) which was based mainly on reductions in expenditure spread between 2004 and 2008. The initially neutral and then gradually more restrictive fiscal stance is likely to be similar for government as a whole. (2006 OECD Economic Surveys, p.29)

As argued in the 2006 Article IV report, the authorities were confident that they would meet an objective of a structurally balanced budget by 2007. The main idea of the debt brake mechanism was to restrain the annual expenditure growth to 1.7 percent per year in 2006-09 (almost half the rate of nominal GDP growth).

Therefore, the fiscal stance of Switzerland in 2006 receives score 1.

Switzerland 2007: 0

From the 2007 Article IV report (p.13):

> The staff agrees that the debt-brake, which seeks balance over the cycle, has been instrumental in reaching the 2006 surplus. However, it applies only to the confederation, excluding social security, and does not provide an anchor for long-term fiscal sustainability.
>
> The budget aims at a surplus in 2007, but extraordinary off-budget expenditures exceeding 1 percent of GDP were planned for 2008. These include the creation of a new permanent off-budget infrastructure fund and funding of a public pension obligation—all outside the debt brake.
>
> To compensate, the authorities cut discretionary spending, were negotiating structural reductions in government tasks and subsidies, and planning a VAT increase for the disability fund. The staff expressed concern about the extraordinary expenditures and that fiscal policy was becoming procyclical. The authorities explained that their objective is to bring all outlays into the fiscal target over the medium-term—safeguarding the spirit of the debt brake. However, they said that some operations are lumpy and one-time and can not be accommodated in the annual debt brake rule. They would continue debt reduction, including with further sales of Swisscom shares.

While most measures in order to implement the "debt brake" rule already took place in 2005-2006, the fiscal stance in 2007 receives score 0, as broadly neutral.

Switzerland 2008: -1

Following the strong performance of the budget in the previous two years, the authorities expect the balance to weaken and provide some stimulus in 2008 for reasons described above. From the 2008 Article IV report (p.24):

> An overall surplus of 0.8 percent of GDP is projected for 2008 […], representing a big swing from a surplus of 2.2 percent in 2007. The authorities explained that the stimulus will, however, be small. About 1 percent of GDP constitutes extraordinary expenditures, with the bulk of it a transfer to the Infrastructure Fund. However, only about a quarter of this will be spent in this fiscal year.
>
> Another ¼ percent of GDP reflects accounting changes that reports expenditures already incurred in 2007 in the 2008 budget. The authorities stated that the modest positive impulse was not intended since their experience has been that a stimulus cannot be well timed and the additional expenditures largely increase imports.

The IMF staff are alarmed that under current policies the debt will begin to increase in about 15 years. Therefore, some concrete measures have to be proposed to contain social expenditures.

> The authorities reported that while specific new actions had not yet been determined, the focus is likely to be on: (i) an increase in the VAT rate to finance disability insurance; (ii) an orderly reform of social benefits; and (iii) containment of health care expenditures. The debt brake rule is to be augmented to cover extraordinary expenditures. (2008 Article IV report, p.24-25).

Due to extraordinary expenditure as well as the support for UBS that affected the budget balance to the extent of around 1 percent of GDP, the fiscal stance of Switzerland in 2008 receives score -1 as moderately expansionary.

Switzerland 2009: -2

As argued in the 2009 Article IV report, Switzerland benefited from its strong macroeconomic and fiscal fundamentals as it went into the crisis. However, the large financial sector was affected at an early stage, and the impact of the crisis on the real economy was significant as well. According to OECD Economic Surveys, the Swiss fiscal stimulus was quite limited. The stimulus package in 2009 included measures of about 3.7 billions of CHF which is roughly equal to about 0.6 percent of GDP. Most of them were expenditure measures, such as road and railways infrastructure, regional policy, R&D, environment, rehabilitation, employment policies as well as measures on cantonal and communes level.

From the 2009 Article IV report (p.30):

> Planned stimulus measures—and full use of automatic stabilizers—will result in a general government deficit in 2009. The federal government's plan to cancel some deferred corporate tax liabilities, to bring forward investment spending (which triggers cantonal cofinancing expenditures) as well as additional cantonal discretionary measures, will result in a fiscal stimulus of about 0.8 percent of GDP.
>
> The authorities will consider an additional stimulus for the 2010 budget. At ¾ percent of GDP, current measures are smaller than those envisaged in other European countries. The mission argued that additional fiscal stimulus when part of a coordinated approach, could help dampen a negative confidence spiral.

From Article IV 2009 Statement by the Executive Director for Switzerland (p.3 of the Statement):

> Against the backdrop of strong fiscal performance at all levels of government during recent years, Switzerland can allow the full use of its automatic stabilizers. This, together with the discretionary measures adopted at the federal and cantonal level for 2009, will provide a combined stimulus of around 1.4 percent of GDP. Staff's estimate is lower, which partly reflects the definition of stimulus measures.

Given the limited size of the discretionary stimulus and the full use of automatic stabilizers to stimulate the economy, the fiscal stance of Switzerland in 2009 receives score -2.

Switzerland 2010: -1

From the 2010 Article IV report (p.3):

> Fiscal consolidation should be limited to what is needed to respect the debt brake rule, while giving more attention to longer term issues. In spite of the recession and of stimulus measures of around ¾ percent of GDP in 2009 and 2010, the small surplus in 2009 is expected to only turn to a limited deficit in 2010. To comply with the debt brake rule, some consolidation is being contemplated for 2011–13. Prudent fiscal policies resulting in low debt levels have served the country well and are warranted, given large potential liabilities related to the banking sector and ageing effects.

Although the authorities start to devise a consolidation plan for 2011-13, in 2010 the fiscal stance remained accommodative. According to the 2009 OECD Economic Surveys, the fiscal support package was of about 0.5 percent of GDP in 2010, with the majority of measures on the expenditure side. So the score is -1.

Switzerland 2011: 0

According to the 2011 Article IV report (p.15):

> The Swiss fiscal position has been little affected by the crisis. With limited fiscal stimulus measures during the crisis (0.4 percent of GDP at central government level, and an estimated 1.4 percent overall) and relatively small automatic stabilizers, Switzerland is exiting the crisis with comparatively strong fiscal balances. The central government balance reached a surplus of 0.5 percent of GDP in 2010, compared with 0.8 percent in 2007, while the general government also remained in surplus (0.2 percent of GDP in 2010 compared with 1.9 percent in 2007) despite a sharp increase in the social security deficit. Overall, the general government debt-to-GDP ratio is at 55 percent of GDP on a GFSM basis (down from 57 percent in 2007).
>
> The fiscal stance is expected to be broadly neutral in the near term. Under the baseline scenario, small surpluses are expected to persist at the general government level over a medium-term horizon. At the Confederation level, the surplus will be negatively affected in the next few years by envisaged tax reforms (including the elimination of stamp taxes on bond issuance and corporate taxes on reinvested capital) and reduced future distributions of SNB gains. This will be compensated by a planned consolidation, in accordance with the “debt brake” rule (0.5 percent of GDP over three years).

Although reform aimed at increasing the female retirement age was not successful, unemployment insurance has been significantly reformed.

> To tackle the structural deficit of the unemployment insurance system (about SFr 1 billion annually), the contribution rate has been increased from 2.0 to 2.2 per cent of annual salary (up to a limit of SFr 126,000) and a solidarity contribution of 1 per cent

> has been introduced for salaries between SFr 126,000 to 315,000. These two reforms should enable the system to get back to balance. (2011 Article IV report, p.16)

In 2011, Swiss authorities gradually removed the fiscal stimulus, but because of the comfortable fiscal position did not have to rush with consolidation measures. Therefore, the fiscal score of Switzerland in 2011 is 0.

Switzerland 2012: 0

From the 2012 Article IV report (pp.6-9):

> The fiscal position is healthy and government debt low, with a broadly neutral stance projected for 2012. The general government balance, which stayed in positive territory in the 2009 recession, continued to register a surplus in 2011 (estimated at 1/2 percent of GDP on a GFSM basis). In particular, social security swung back into surplus due to reforms to unemployment insurance and a VAT increase earmarked for financing invalidity pensions. In contrast, the federal government surplus disappeared, reflecting in part measures to counteract the effects of the strong Swiss currency (some 0.15 percent of GDP) introduced in August 2011. The projected fiscal stance in 2012 and beyond is broadly neutral, with a small deficit at the federal level compensated by surpluses in the other components of general government. The debt-to-GDP ratio is projected to fall further to some 45 percent of GDP in 2015.

As the compliance with the "debt brake" rule did not require any fiscal consolidation, the fiscal stance remained neutral and receives score 0.

Switzerland 2013: 0

Despite some macroeconomic stability and exchange rate appreciation, which culminated in an adoption of the exchange rate floor against the euro, the fiscal position, anchored in fiscal rules and discipline, remained healthy. According to the 2013 Article IV report:

> In Switzerland, discretionary fiscal policy is limited by the structurally balanced budget rule ("debt brake") at the federal level and other fiscal rules at the cantonal level. The former caps the federal expenditure while allowing tax revenues to act as automatic stabilizers. […]
>
> Reforms to unemployment insurance and a VAT increase earmarked for financing invalidity pensions allowed the social security funds to improve its balance, while the federal government, cantons, and municipalities ran small deficits. The fiscal stance in 2013 is forecast to be broadly neutral, with a small deficit at the federal level and municipalities compensated by surpluses in the other components of the general government. The debt-to-GDP ratio is expected to fall further to about 45 percent of GDP in 2016. (p.11)
>
> The authorities do not see a more expansionary fiscal stance as necessary. Though they also expect a negative output gap in 2013–14, they remained skeptical about the usefulness of fiscal policy for cyclical stabilization beyond the operation of automatic

> stabilizers. They were also concerned that further government spending would mainly stimulate the nontraded sector, which is relatively healthy. (p.17)

The neutral fiscal stance of Switzerland in 2013 receives score 0 in the classification.

Switzerland 2014: 0

According to the 2014 Article IV report (p.6):

> In 2014, the fiscal stance is expected to be broadly neutral. The general government should record a small deficit largely reflecting the lack of a profit distribution from the SNB and one-off restructuring contributions towards cantonal pension funds. Going forward, cantonal finances will be under some pressure because of the continuing need to raise the funding ratio of cantonal pension funds and changes in the hospital financing scheme. In addition, the corporate tax reform which is envisaged to enter into force as of 2018 is likely to lead to a revenue loss for cantons (see below). To prepare for the potential revenue loss as part of the burden sharing agreement with cantons, the federal government plans to restrain spending and implement a consolidation package.
>
> All in all, the structural balance should remain close to zero beyond 2014, with deficits at the cantons and communes level offset by surpluses in the federal government and social security funds. The debt-to-GDP ratio should fall to 44 percent of GDP in 2017.

Therefore, the score for the fiscal stance remains 0.

Switzerland 2015: 0

In 2015, Switzerland once again had to contend with capital flow volatility. Following the exit from the exchange rate floor and subsequent franc overvaluation, the Swiss economy faced slower near-term growth prospects and deflation. Despite this, the authorities believed that the scope for fiscal policy to support aggregate demand was limited. According to the 2015 Article IV report:

> Fiscal policy can still support recovery by allowing automatic stabilizers to operate freely, as allowed under the rule. The rule's escape clause should be triggered in the event of a severe downturn to allow discretionary fiscal stimulus, as monetary policy would likely be overburdened in such a scenario. (p.1)
>
> However, fiscal policy should do what it can to support demand. In the central scenario, fiscal automatic stabilizers should be allowed to operate fully, as allowed by the rule. The authorities should also avoid budgeting overperformance against the rule in 2016, as this would add an unnecessary contractionary impulse. If a deep or prolonged recession materializes, discretionary fiscal easing should be employed to support growth and inflation and avoid overburdening monetary policy. Such easing could be achieved by temporarily suspending the rule under established procedures. (p.19)

In 2015, the authorities attempted to address longer-term fiscal challenges.

> The reform includes measures to equalize retirement ages for men and women and to reduce the rate at which pension savings are converted into pension annuities by reducing this conversion rate from 6.8 to 6.0 percent per annum. In addition, the government has proposed to increase VAT rates by 2 percentage points by 2029 to ensure more stable funding for the pension system.
>
> Switzerland has prepared a comprehensive corporate tax reform (Corporate Tax Reform III). Switzerland has faced international pressure in recent years to reduce the favorable tax treatment provided to multinational corporations in many cantons. (2015 Article IV report, p.19)

In 2015, although the authorities allowed the automatic stabilizers (relatively small compared to other OECD countries) to support the slowing economy, they maintained the debt containment rule, did not rely on the discretionary measures and prepared some long-term reforms. The fiscal stance remained broadly neutral in 2015 and receives score 0.

Iceland

Iceland 2006: -1

An economic boom initiated by expansion in the aluminium sector had generated large and growing imbalances in the current account, inflated the balance sheets of Icelandic banks, and boosted aggregate demand and inflation. Markets became concerned about those vulnerabilities that threatened the financial stability of the economy. The IMF suggested that a tighter fiscal stance would be appropriate in 2006, but the authorities decided to tighten starting from 2007. According to the 2006 Article IV report, the main reasons were lags in the planning process, and the political economy setting provided by the upcoming general election.

According to the 2006 OECD Economic Surveys (p.13):

> However, while monetary tightening aimed at curbing inflation pressures continues, the fiscal stance, as measured by the change in the cyclically-adjusted primary balance, is estimated to be loosening inappropriately in 2006. The main reason for this is substantial tax cuts decided in 2003 for structural reasons. With macroeconomic imbalances considerably wider than expected when the 2006 budget was adopted, a tightening of fiscal policy is required. This could be achieved using a spending restraint, for example, through wage moderation and delaying public investment.

Iceland 2007: -2

Following three years of rapid economic expansion, some signs of slowing have emerged. Due to the economic boom the fiscal balance of Iceland has improved significantly. The fiscal balance swung from a deficit of almost 3 percent of GDP in 2003 to a surplus of just over 5 percent of GDP in 2006. A large portion of this upswing was cyclical and the policy

stance eased in 2007 by about 1.5 percent of GDP. This included income tax reductions (-0.3% of GDP impact), VAT and excise tax reduction (-1% of GDP impact) and Expenditure slippage (-0.5% of GDP impact). Therefore, the fiscal score of Iceland in 2007 is -2.

Iceland 2008: -1

The long expansion came to an end, exposing the economy's overstretched private sector balance sheets, large macroeconomic imbalances, and high dependence on foreign financing. According to the 2008 Article IV report (p.9):

> Both sides expected the fiscal position to deteriorate to a varying degree—due to a weaker economy and stimulative policy measures—and spending pressures to rise. The MoF projected the general government balance to turn into a deficit of 1¾ percent of GDP in 2010, a 7 percentage point deterioration since 2007. Cyclical factors explain about half of the deterioration, while the rest reflects structural measures, including a sharp increase in public investment in 2008, the implementation of announced tax cuts, and higher spending in 2009–10.

Overall, in 2008, according to the 2008 Article IV report, the authorities planned a structural adjustment of 0.7 percent, which resulted in a fiscal stance score of -1.

Iceland 2009: 3

The collapse of the banking sector and the sharp recession have put the public finances in a dire situation. The government support to the banking sector meant that the debt-to-GDP ratio went up from almost zero to more than 100 percent, requiring decisive actions to stop the economy falling into a debt spiral.

According to the 2009 OECD Economic Surveys (p.84):

> Early in 2009, the government hiked the flat rate on the personal income tax from 22.75% to 24.1% and local authorities raised their rates, on average, from 12.97% to 13.1%. These actions are estimated to yield ½ per cent of GDP. At the same time, the government also postponed expenditures – for transfer payments, operational expenditures and investment spending – that had been budgeted before the burst of the crisis. These measures should save 2½ per cent of GDP. In May, additional revenue measures – on alcohol, tobacco, gasoline and vehicle licensing – were introduced, narrowing the fiscal gap by a further ½ per cent of GDP. The government presented to Parliament in late June a preliminary medium-term fiscal consolidation plan for 2009-13 to achieve balance in public finances, with a final version due to be presented to Parliament in October 2009 along with the 2010 budget proposal. Under the plan, additional taxes were introduced and expenditures trimmed further in 2009, yielding fiscal savings of about 1% of GDP.

Also, the government announced its intentions to immediately reverse the tax cuts implemented over the boom years:

> As announced by the government, the starting point for the fiscal consolidation programme should be to reverse the tax cuts implemented over the past decade, which

> Iceland can no longer afford. Above all, the PIT and the VAT should be raised to the levels that prevailed just a few years ago. There is also room to increase the tax rates levied on corporate income and capital income, and the wealth tax could be re-introduced. (2009 OECD Economic Surveys, p.88).

The consolidation programme includes a range of measures to improve revenue collection and to contain public spending. In total those measure are estimated to save about 4 percent of GDP until 2013

According to the 2011 OECD Economic Surveys, in 2009 the revenue boosting measures improved the balance by 1.9 percent of GDP, and expenditure containment measures saved 3.2 percent of GDP. Due to the large-scale fiscal consolidation of about 5 percent in 2009, the fiscal stance of Iceland in 2009 is scored at 3.

Iceland 2010: 3

According to the 2010 Article IV report, the economy was starting to rebound from its deep post-crisis recession, helped by the consolidation programme. The general government deficit was cut from 6.9% to 2.8% in 2010. However,

> The authorities and staff agreed on some minor modifications to fiscal adjustment targets. The 2011 general government primary surplus target was reduced from 1¼ to ½ percent of GDP, while the medium-term target was reduced from 6¾ to 6 percent of GDP. The combination of growing risks to the economic outlook and ample financing motivated the change for 2011, while strong projected debt dynamics underlie the medium-term modification. (2010 Article IV report, p. 16)

According to the 2011 OECD Economic Surveys, in 2010 the revenue measures improved the balance by 2.8 percent of GDP, and expenditure containment measures saved 3.6 percent of GDP. Due to these continuing substantial consolidation efforts, the fiscal stance score of Iceland in 2010 was unchanged at 3.

Iceland 2011: 3

According to the 2011 OECD Economic Surveys (p.30),

> The targets of the consolidation programme for both 2009 and 2010 were met. The primary general government budget deficit was held to 6.9% of GDP in 2009 and cut to 2.8% of GDP (excluding the one-off cost of called loan guarantees) in 2010. The 2011 budget is designed to achieve a primary surplus of about 1% of GDP. Consolidation measures are again more focused on the expenditure side of the budget than the revenue side. Expenditure cuts involve, as before, a freeze on wages and benefits, some selective cuts in large expenditure items (road construction and child benefits), graded targets for contracting operational costs and subsidies with more stringent targets for general administration, supervision and services and more lenient targets for welfare services and medical insurance.

Overall, consolidation amounted to 1.7 percent on the expenditure side and 0.8 percent on the revenue side.

Although most of the consolidation took place in 2009-2010, the consolidation measures still exceeded 2 percent of GDP 2011 which resulted in score 3 describing the fiscal stance.

Iceland 2012: 1

According to the 2012 Article IV report (p.1):

> Iceland is gradually emerging from its severe post-crisis recession. Domestic demand is driving growth and unemployment is declining, but inflation remains high. Imbalances are unwinding, but all sectors of the economy remain highly leveraged. The outlook is for a moderate recovery, but risks emanate from both external and domestic sources.

From the statement by the Executive Director for Iceland (p.2 of the Statement):

> After implementing a fiscal consolidation of over 9 percent of GDP mostly in the two year period 2009-2010, some expenditure overruns in 2011 increased the primary general government deficit to one percent of GDP. Staff estimates that this implies that the 2012 primary surplus will be positive but lower than previously envisaged. Staff proposes additional measures amounting to 1/2 percent of GDP to correct the course in 2012. Despite the observed slippages, our authorities still aim to achieve their medium term objectives: an overall balance in 2014 and a sizable surplus thereafter.

As the economy started emerging from the deep recession, the pace of fiscal consolidation subsides with planned consolidation of about 0.5 % of GDP. The fiscal stance score is therefore revised to 1.

Iceland 2013-2015: all 0

Overall, the economic conditions have been improving over 2013-2015, economic activity surpassed its pre-crisis peak in 2015, and fiscal and external balances have remained in surplus since 2014. According to the 2013 OECD Economic Surveys (p.34):

> Fiscal consolidation has had little impact on growth because fiscal multipliers are low, as in other small open economies with flexible exchange rates, and Iceland has been able to compensate for fiscal drag by running a more accommodative monetary policy than otherwise.

With the majority of consolidation measures implemented in 2009-2012, Iceland had a broadly neutral fiscal stance in 2013-2015. Amongst important fiscal decisions were the reform of the VAT system and the adoption of a draft budget framework law, which mandates a balanced budget over the medium term.

The fiscal stance score for all three years is set to 0.

Turkey

Turkey 2006-2007: -1 and 1

A significant progress had been made since the 2001 crisis. The large output gap was closed, public debt ratios were significantly reduced, economic institutions strengthened, and the financial system normalized. This revival was due to disciplined financial policies, advances in structural reform, political stability, and favourable global economic conditions. Multi-year budgeting being implemented in Turkey since 2006 increased predictability and strengthened the transparency principle in public financial management.

According to 28th Annual OECD Senior Budget Officials Meeting on Budgeting in Turkey, however,

> A significant problem for the assessment of Turkish fiscal policy is that, apart from Mexico, Turkey is the only OECD country that does not publish government fiscal accounts according to National Accounting Standards (SNA93 or ESA95). However, in 2006, the accounting framework for the government sector was revised in accordance with international standards (although not yet entirely). (p.6)
>
> Currently the main fiscal policy indicators are the overall balance and primary balance of the central government budget, and the total and primary balance of the "Consolidated Government Sector". In order to submit fiscal notifications to the European Commission, huge efforts have been made to prepare accounts in accordance with ESA 95 standards. The ambition is to produce accounts in accordance with ESA 95 for the year 2009. (p.41)

According to the 2006 OECD Economic Surveys (p.62),

> While the overall fiscal stance has been relatively tight over the past few years, the practise of targeting the actual primary balance means that it became less tight during the recent cyclical upswing, at a time when the widening current account deficit would have argued for more contractionary fiscal policy. In order to prevent such pro-cyclical behaviour in future, the government has recently announced an intention to complement the annual primary balance target with an expenditure cap. This effectively implies that the automatic stabilisers will be permitted to work asymmetrically, in the sense that the primary surplus would be permitted to exceed 6.5% of GDP in conditions of economic strength, but that the government would still take measures to preserve the target if revenues disappoint.

The fiscal policy was a cornerstone in improving macroeconomic conditions.

> High primary surpluses (averaging 6.7 percent of GNP since 2002) have supported private sector-led growth by reducing debt ratios and enabling lower interest rates and risk premiums. The fiscal adjustment has, however, relied excessively on tax increases and investment cuts, and too little on current expenditure rationalization. However, recurrent ad-hoc tax and spending initiatives outside of the budget cycle often required suboptimal offsetting measures in the form of investment spending cuts or excise tax hikes. Last year, large one-off revenues were used to accommodate higher spending; thus, the primary surplus adjusted for exceptional items fell to around 5 percent of GNP—even though the headline figure was 6.6 percent of GNP […]. This

> imposed a considerable adjustment in this year's budget, which is proving difficult to deliver. (2007 Article IV report, pp.22-23)

Overall, the fiscal strategy followed the trend established as of 2001 with a primary fiscal surplus target at 6.5 % of GDP. However, recurrent ad-hoc tax and spending initiatives outside of the budget cycle in 2006 required offsetting measures in the form of investment spending cuts or excise tax hikes.

> In the short term, keeping to the announced fiscal spending targets will help confidence, support disinflation, and bolster domestic saving. This year, the authorities blocked some 0.8 percent of GNP in outlays to (i) offset 2006 spending overruns (as per program commitments), (ii) compensate for several unbudgeted initiatives, and (iii) close the gap in the state enterprise balance opened by the failure to effect planned hikes in end-user energy tariffs […]. Implementation of these measures should enable a primary surplus of some 6.7 percent of GNP. (2007 Article IV report)

Therefore, the fiscal score is set at -1 for 2006 and at 1 in 2007, as moderately expansionary and tightening respectively.

Turkey 2008: -1

According to the 2008 OECD Economic Surveys (p.63 and p.67): "There were important fiscal slippages in 2007 that reflected a number of factors. Most important perhaps were the electoral spending pressures that gradually built up during the first half of the year. The slowing down of the economy – with growth of real GDP decelerating from 7.6% in the first quarter of 2007 to 3.4% in the fourth quarter – also adversely affected tax revenues, and in particular indirect tax revenues and specifically VAT receipts. In addition rising input costs combined with price restraint affected the performance of the SEEs, and the problems of the state energy companies further aggravated the fiscal situation. Moreover, there were large increases in current transfers to the social security institutions, agricultural support payments and health expenditures. (p.63)

There is a case now for Turkey adopting a somewhat more sophisticated type .of anchor for fiscal policy. The dominant primary surplus anchor was relevant when public debt was very high and the priority was to bring it down to sustainable levels. In this context Turkey could consider moving towards an expenditure rule with binding multi-year ceilings for aggregate government spending. (p.67)

According to Medium Term Fiscal Plan 2008-2010 (p.8):

> In 2008-2010 period, central government budget deficit is estimated to have a downward trend. The ratio of budget deficit to GDP which was stipulated as 2.8 percent in 2007 central government budget (public administrations within the scope of general government and the special budget administrations) is estimated to decrease to 2.6 in 2008, 0.9 in 2009 and 0.3 in 2010. Thus, as a result of decisive continuation of fiscal discipline achieved in recent years, budget deficit will no longer pose a problem and a healthily determined budget structure will be achieved after years. During the

> term of the fiscal plan, a primary surplus (in terms of its ratio to GDP) of 5.6 percent has been estimated for 2008, 5.4 percent for 2009 and 5.1 percent for 2010. High primary surplus will ensure that the downward trend in public debt stock continues. This will also enable that the nominal and real borrowing interests will be decreased rapidly.

Overall, having achieved sustainable debt level, the government moved away from using 6.5 % of GDP as a primary budget surplus target. For 2008, it was set at 5.6 % of GDP which is almost 1 percentage point lower than before. Therefore, the fiscal stance receives a score of -1.

Turkey 2009: -2

According to Medium Term Fiscal Plan 2009-2011 (p.1 and p.5):

> Main priorities have been decided as increasing the competitiveness of the economy, ensuring efficiency in public expenditures and reducing inter-regional development gaps. On the other hand, it has been also stated that a primary surplus policy aimed at continuing the downward trend in public debt stock will be pursued. (p.1)
>
> The ratio of central government budget deficit to GDP has been estimated to be realized as 1.4 percent in 2009, to decrease to 1.3 percent in 2010 and be recorded as 1.7 percent in 2011.
>
> During the term of the Fiscal Strategy, (in terms of its ratio to GDP) a 3.7 percent primary surplus has been estimated for 2009, 3.1 percent for 2010 and 2.6 percent for 2011. This primary surplus target will ensure that the downward trend of public debt stock will continue and that the ratio of gross public debt stock (EU definition) to GDP will decrease to 31 percent at the end of the term of Fiscal Strategy. This will also enable a decrease in the borrowing interests. (p.5)

It was announced that primary expenditures in 2009 were to rise to by 24.4 billion YTL (2.28% of GDP) compared with what was planned in the previous Medium Term Plan. The largest portion of this increase was on current transfers (14.1 billion YTL, 1.32% of GDP) and personnel expenditures (6.1 billion YTL, 0.57 % of GDP).

Since the target for the primary fiscal balance was reduced from 5.5% of GDP to 3.7% of GDP, the fiscal stance is described with the score of -2 in 2009.

Turkey 2010: 1

According to the 2010 Article IV report:

> The NFPS primary balance declined by 4 percentage points during 2007-09 to a deficit of 1 percent of GDP (although the 2009 outturn was considerably better than anticipated due in part to an unexpectedly strong growth recovery). The debt-to-GDP ratio rose by 6 percentage points to 45 percent.
>
> Cyclical revenue loss accounted for the bulk of the deterioration in the nonfinancial public sector (NFPS) primary balance. However, an across-the-board discretionary

> loosening (including a long-planned 5 percentage point cut in social security premiums, a sizable increase in the real wage bill, and increased investment spending), unrelated to the downturn, was already underway when the crisis hit in late 2008. Subsequently, a package of targeted stimulus measures was adopted in early 2009 that included expanded short-time unemployment benefits and temporary tax cuts on purchases of cars and other durables, with the latter effective in boosting demand for these products.[…]
>
> The NFPS primary balance declined by 4 percentage points during 2007-09 to a deficit of 1 percent of GDP (although the 2009 outturn was considerably better than anticipated due in part to an unexpectedly strong growth recovery). The debt-to-GDP ratio rose by 6 percentage points to 45 percent. (p.13)
>
> In 2010, staff expected revenue to overperform considerably because: (i) the 2009 revenue outturn was 0.9 percent of GDP higher than assumed in the 2010 budget; and (ii) 2010 nominal GDP growth is projected to be 6 percent higher than budgeted. Staff urged the authorities to save revenue overperformance by adhering closely to budgeted spending levels and maintaining current tax and formula-based energy pricing policies. Under staff's revenue projection, this would improve the primary balance to at least 0.6 percent of GDP (compared to the current target of -0.3) and ensure a sizable structural improvement. (p.21)

Therefore, the fiscal score turns to 1 as moderately tightening.

Turkey 2011: -2

According to the 2010 Article IV report (p.22):

> From 2011, the government will apply a deficit-based fiscal rule, which it viewed as a major addition to Turkey's institutional framework—on a par with central bank independence and inflation targeting. The proposed rule requires (allows) a specific amount of tightening (loosening) each year in proportion to how far the overall deficit is above (below) the medium-term target (set at 1 percent of GDP) and GDP growth is in excess (falls short) of its average long-term real growth rate (set at 5 percent).

From Medium-Term Plan 2011-2013 (p.2):

> In medium and long term, infrastructure investments supporting efficiency and productivity in economy will be focused. Infrastructure investments on education, health, technological research, transportation, drinking water and development of information and communication technologies will be prioritized. Giving priority to Southeastern Anatolia Project (GAP), East Anatolia Project, Konya Plain Project; public investments will focus on economic and social investment projects. Measures will be taken timely with a view to fast completion of GAP Action Plan and projects falling under the scope of other regional programs, considering additional sources provided. Investments which are required to implement the policies and priorities on the way to EU membership will be given impetus.

Overall, the effect of these measures on the budget balance was at least 1.1% of GDP and the fiscal stance score in 2011 is therefore -2.

Turkey 2012: -1

According to the 2012 OECD Economic Surveys (p.22),

> Fiscal policy is managed under a rolling three-year economic programme, updated each autumn. This framework has been effective, and allowed for a targeted and temporary stimulus package during the crisis in 2009. After this countercyclical stimulus, fiscal policy outperformed the headline objectives of the 2010 and 2011 programmes, thanks to stronger-than-projected GDP growth and sharp revenue – including from a sizeable restructuring scheme of public receivables.

Overall, the primary surplus target was revised up by 0.5 ppt to 2% in 2012. However, such a revision was mainly due to better than expected revenue performance. Moreover, according to the 2012 Article IV report, the increase in public expenditures was pro-cyclical, while a neutral stance would be more appropriate. Therefore, the fiscal stance score changes but only to -1.

Turkey 2013: -1

From the 2013 Article IV report:

> The macroeconomic assumptions underlying the medium-term program (MTP) are more conservative than last year's. In particular, the growth trajectory has been shifted downwards by 1 percentage point in 2014 and inflation has been revised up for 2013–14. (p.10)
>
> The authorities are on track to meet their 2013 budget targets, despite rapid spending growth. The budget contemplates a central government primary surplus of 0.5 percent of GDP, very close to last year's outturn, and the performance to August is consistent with this target. This, however, masks an expansionary fiscal stance as expenditures are growing well above nominal GDP on the back of revenues boosted by one-off factors. Nominal central government revenues grew 17 percent y-o-y in the year to August, compared with 9 percent growth last year. Privatization revenues and repayments of tax arrears by public companies have already exceeded the full year targets. The government has then made use of these windfalls to increase capital spending beyond the budget ceiling. As a result, primary spending grew by 15 percent in the year to August, versus a full year target of 11 percent in the budget.
>
> Thus, staff argued that fiscal policy is too loose. The ½ percent of GDP deterioration of the structural primary balance expected for this year, together with high nominal spending growth, is indicative of an expansionary stance. Current levels of spending growth are too high for an economy that expanded at more than 7 percent annualized in the first half of the year, where inflation is at 8 percent, and where the current account deficit is high. (pp.15-16)

Broadly, the fiscal stance in 2013 was little changed from the two previous years, and also receives a score of -1.

Turkey 2014: -1

From the 2014 Article IV report (p.12; p.14 and p.25):

> Turkey's economy has grown by an impressive 6 percent on average since 2010. The economy recovered swiftly from the great financial crisis and unemployment dropped to its lowest level in the last decade. (p.25)
>
> In 2014, the budget primary surplus target is likely to be missed. Although, due to high inflation, growth of central government revenues is in line with the budget forecast despite weaker domestic demand, expenditures have been allowed to grow above the budget ceilings. […] The structural deficit remains large, although debt sustainability is not a concern […]. Despite relatively strong headline fiscal indicators, the structural deficit remains large at about 3 percent of GDP this year. (p.12)
>
> Thus, the mission recommended frontloading the adjustment in the next two budgets, targeting an increase in the primary balance of 1½ percent of GDP by 2016, and an additional ½ percent in 2017 in the 2015–17 MTP. The recommended adjustment is skewed towards expenditure rather than revenue measures. This is because indirect taxation is already high, there are some upside risks to personnel, social security and capital expenditures, and because budget flexibility needs to be preserved. (p.14)

Overall, the projected primary surplus, expenditure and revenue targets were not revised since the previous Medium-Term Programme. The fiscal stance remained expansionary and receives the -1 score.

Turkey 2015: 1

According to the 2015-2017 Medium Term Plan (p.3):

> It is estimated that the 2015 central government budget deficit-to-GDP ratio will be recorded as 1.1 percent, and 0.7 and 0.3 percent in 2016 and 2017 respectively. In the Medium Term Fiscal Plan period, it is forecast that the primary surplus-to-GDP ratio will be recorded as 1.7 percent, 1.8 percent and 2 percent in 2015, 2016 and 2017 respectively.

The primary surplus target was revised up by 0.5 ppt to 1.7% of GDP. This was due to a windfall of revenues which overshoot the target set in a previous programme while the planned expenditure growth revision in 2015 was minimal. Overall, in 2015 the fiscal stance turned from expansionary to moderately tightening and receives a score of 1.

Norway

Norway 2006: 0

According to the 2006 Budget (Press release):

> The performance of the Norwegian mainland economy continues to be strong, and growth in the mainland economy is now well above trend. Employment is picking up and the unemployment rate is falling. A broadly neutral fiscal policy stance is therefore maintained to limit the growth impetus to the mainland economy from the use of petroleum revenues. Growth in Mainland Norway GDP (excluding petroleum and shipping) is forecast at 3¾ per cent in 2005 and 2 ½ per cent in 2006.
>
> The guidelines for economic policy in place since 2001 stipulate that fiscal policy shall be geared towards a gradual and sustainable increase in the use of petroleum revenues. Over time, the structural, non-oil central government budget deficit shall correspond to the real return on the Government Petroleum Fund, estimated at 4 per cent. However, the actual implementation of fiscal policy must take into account business cycle fluctuations around the suggested medium-term path.
>
> A non-oil fiscal deficit estimated at NOK 77 billion. This deficit is covered by a transfer from the Government Petroleum Fund. Priority has been given to international aid, R&D, education, mental health care and to investments in public transport and infrastructure. This budget includes a second year of the tax reform implementation, nearly completing the reform. The Government also aims at continuing the process of making the tax system more efficient and fair. The Government's proposed tax changes amount to net reductions of about NOK 2.8 billion in 2006.

Overall, in 2006 the economic upswing in Norway continued. The windfall of oil revenues had boosted the Government Petroleum Fund over recent years. In 2006, the fiscal stance remained neutral, with the non-oil deficit close to the target of 4 percent of GPF assets. Therefore the fiscal score of Norway in 2006 is 0.

Norway 2007: -1

Economic conditions remained favourable: real GDP growth remained above potential, inflation was moderate and rising oil prices continued to boost the budget revenues.

According to the 2007 Article IV report (p.9):

> The 2007 budget outturn will most probably achieve the 4-percent rule, but the fiscal stance will nevertheless be somewhat expansionary. The budget implies a central government non-oil structural deficit only marginally greater than 4 percent of the GPF, but staff estimates that the general government non-oil structural budget deficit is set to rise by about ½ percent of GDP in 2007 [...]. Given the cyclical situation, the mission argued that any budgetary overperformance in 2007 be used for deficit reduction. Likewise, budgets for 2008 and beyond should aim for deficits well below 4 percent of the GPF until demand pressures ease. Such a policy is fully consistent with the fiscal guidelines, which explicitly allow for countercyclical policy.

A slightly expansionary widening of about 0.3-0.4 percent in terms of the structural non-oil deficit results in a fiscal score of -1.

Norway 2008: 1

According to 2008 Budget (Press release):

> The Norwegian economy is experiencing its strongest expansion in thirty years, with annual growth in Mainland-GDP averaging more than 4½ per cent over the past four years. Employment has increased substantially and the unemployment rate has fallen to a historically low level. Real wage growth is high, due to low consumer price inflation, while producer costs have picked up only moderately so far. In order to underpin continued balanced developments of the economy, the Government proposes a Fiscal Budget for 2008 with an estimated structural, non-oil deficit that is lower than the expected real return on the Government Pension Fund – Global.
>
> When capacity utilisation in the economy is high, this calls for fiscal policy restraint relative to the medium term rule, whereas in a cyclical downturn somewhat higher spending of oil revenues may be justified. Even though a growing fund will allow for increased spending of petroleum revenue in the future, long-term budget challenges persist due to even stronger increases in pension costs and other age-related expenses.
>
> The Government proposes a Fiscal Budget for 2008 with a structural, non-oil budget deficit of NOK 76.8 billion, which is NOK 7 billion lower than the expected real return on the Government Pension Fund – Global.

Therefore, the fiscal stance in 2008 became slightly tightening and receives a score of 1.

Norway 2009: -3

The developments in global financial markets suggest that the cyclical peak has passed, and increase the uncertainty about the outlook for the economy. According to the Budget (Press release):

> The Government proposes a Fiscal Budget for 2009 with a structural, non-oil deficit of NOK 92 billion. The structural deficit is on par with the expected real return on the Government Pension Fund – Global, following three years of deficits below the 4 per cent path. This implies an increase in the use of petroleum revenues from 2008 to 2009 of NOK 14 billion in real terms. As a share of Mainland trend-GDP, the structural non-oil deficit increases by 0.7 per cent. The domestic demand stimulus is estimated to be of the same magnitude." The budget implied a real underlying growth in Fiscal Budget expenditures from 2008 to 2009 of 3¼ per cent and an unchanged overall level of taxation.
>
> According to Article IV Statement by Executive Director for Norway 2009 (p.1-2): "An extraordinary January 2009 stimulus package increased the fiscal impulse from 0.7 to 2.4 percent of mainland GDP. The January package was mainly targeted at public infrastructure (both maintenance and investments), supplemented by temporary tax reductions for businesses. In May 2009, in the Revised National Budget, fiscal policy was made even more expansionary, mainly as a result of higher estimated growth in expenditures in the social security system and estimated lower dividends

> from state-owned companies. In the Final Budget Revision for 2009, in late November, the estimated public spending was revised somewhat down and structural taxes somewhat up, resulting in a downward revision of the estimated fiscal impulse in 2009 from 3.0 to 2.7 percent of mainland GDP.
>
> The extraordinary fiscal escalation to counteract the effects of the financial crisis and the global recession has brought spending of petroleum revenues to a high level. The structural, non-oil deficit for 2010 is estimated at NOK 148.5 billion, or 7.8 percent of trend GDP for mainland Norway.

According to Revised Budget 2009, this was "the most expansionary fiscal budget in more than 30 years, and it is also very expansionary in an international context." With the discretionary fiscal stimulus of 2.7 percent of GDP, the fiscal score received by Norway in 2009 is -3.

Norway 2010: -1

From the 2010 Budget (Press release):

> A structural, non-oil budget deficit of about NOK 148.5 billion, which is NOK 44.6 billion more than the expected return on the Government Pension Fund – Global.
>
> An increase in the structural non-oil deficit of NOK 14.6 billion in real terms from 2009 to 2010. Measured as a share of Mainland trend-GDP the structural, non-oil deficit increases by ½ percentage point. Macroeconomic model simulations indicate that the fiscal stimulus from the 2010 budget is somewhat lower than suggested by this indicator.
>
> A real underlying growth in Fiscal Budget expenditures from 2009 to 2010 of 1¾ per cent. An increase in total revenues for local governments of 2.6 per cent in real terms from 2009 to 2010.

Overall, in 2010 the fiscal stance still remains accommodative. Given that the majority of stimulus measures have been implemented in 2010, the fiscal score is revised up to -1.

Norway 2011: 0

According to the 2011 Budget (Press release):

> Several targeted policy measures helped mitigating the effects of the international financial crisis on the Norwegian economy. Following a decline in mainland output of 1.4 per cent in 2009, growth in the Mainland economy is now forecast at 1.7 per cent in 2010 and 3.1 per cent in 2011, the latter about half a percentage point above trend growth. Unemployment has been kept at low levels throughout the downturn and is forecast at 3½ per cent both in 2010 and 2011.
>
> The spending of petroleum revenues, as measured by the structural, non-oil budget deficit, is estimated at NOK 128.1 billion, NOK 7.4 billion above the expected real return on the Government Pension Fund Global. The structural non-oil deficit in 2011

> is estimated on par with the 2010 deficit in real terms. This implies a fiscal tightening of 0.2 per cent of Mainland trend-GDP from 2010 to 2011.
>
> Taxes are kept at the same level as in 2010. The real underlying growth in Fiscal Budget expenditures from 2010 to 2011 is estimated at 2¼ percent, slightly below the average for the last 25 years.

Fiscal policy changes from an expansionary stance in 2009-2010 to a broadly neutral one, and therefore receives a fiscal score of 0.

Norway 2012: 0

According to the 2011 Article IV report:

> The government deployed fiscal stimulus (as measured by the change in the structural non-oil budget deficit) of 2 percent of trend mainland GDP in 2009. Fiscal policy then turned broadly neutral in 2010 and 2011. Together with strong returns on Norway's sovereign wealth fund—the Government Pension Fund-Global (GPF-G)—this brought the structural non-oil deficit back below 4 percent of the GPF-G's capital, the benchmark target under Norway's fiscal guidelines, from which the government can deviate temporarily for cyclical reasons. (p.8)
>
> The 2012 budget aims for a broadly neutral stance. The budget targets a structural deficit approximately equal to 4 percent of the GPF-G's capital—the target under Norway's fiscal guidelines. With the GPF-G's capital growing, the structural non-oil deficit as a percent of trend mainland GDP will increase, but only by 0.3 percent of mainland GDP implying a broadly neutral fiscal impulse. No major discretionary policy changes are planned. (p.22)

According to the 2012 Budget Press release, the real underlying growth in fiscal budget expenditures from 2011 to 2012 is estimated at 2.1 ppt and the level of taxation was planned to be unchanged. Given a neutral fiscal stance, the fiscal score in 2012 remains unchanged at 0.

Norway 2013: 0

According to the 2013 Budget (Press release):

> Despite the challenging global economic environment, the Norwegian economy continues to perform well, and capacity utilisation is now higher than foreseen at the presentation of the Revised National Budget last May. Low interest rates, high income growth and high oil prices have fuelled the economy, says Minister of Finance Sigbjørn Johnsen.

The main features of the 2013 Budget are:

> Spending of petroleum revenues, as measured by the structural non-oil budget deficit is estimated at NOK 125.3 billion in 2013. This is NOK 26.4 billion below the expected real return in the Pension Fund Global and 3.3 per cent of the capital in the Pension Fund Global. The real underlying growth in the expenditures from 2012 to

> 2013 is estimated at 2.4 per cent, of which about close to half stems from growth in old age pensions. Unchanged level of taxation.

Due a broadly neutral fiscal stance and the non-oil structural deficit close to the targeted expected real rate of return of the Government Pension Fund Global, the fiscal score remains unchanged at 0.

Norway 2014: -1

According to the 2014 Article IV report:

> The 2013 fiscal outturn was well within the authorities' fiscal policy rule. The structural non-oil deficit was 3.1 percent of GPFG assets and 5.1 percent of trend mainland GDP. However, the fiscal impulse was slightly positive and lower than expected at 0.2 percent. (p.8)

> The 2014 revised budget entails an expansionary fiscal stance with a non-oil structural deficit of 5.8 percent of mainland GDP. This is equivalent to 2.8 percent of the GPFG assets rather than the 4 percent average real return on GPFG assets assumed for the fiscal rule. However, the 2014 fiscal impulse is projected at 0.7 percent, adding stimulus in an economy roughly at capacity. […] The 2014 budget includes some minor tax reductions. These include: (i) a reduction of the tax rate on personal income from 28 percent to 27 percent; (ii) a reduction of the tax rate on net wealth by 0.1 percentage point to 1 percent; and (iii) the elimination of the inheritance tax. These changes reduce taxes by ¼ percent of GDP in 2014 on an accrual basis. (p.16)

According to the 2014 Budget (Press release):

> The Norwegian Government proposes tax changes from 2014 to strengthen competitiveness and profitability, and stimulate investments in the mainland economy.
>
> The corporate tax rate will be lowered from 28 per cent to 27 per cent. The Government thus takes a first step in a broader reform of the corporate tax regime, aimed at reducing the rates and broadening the tax base. The tax credit scheme for R&D will be increased and a special first year depreciation for machinery will be introduced. At the same time the Government proposes an interest deduction limitation for interest expenses paid to related parties. Interest deduction limitations will create a more level playing field for businesses competing with corporations engaged in extensive tax planning. The resulting increase in tax revenue is estimated at approximately 2.55 billion NOK and will partly finance the above mentioned tax reductions for mainland businesses.

Due to a slight fiscal impulse to support the business activity in a slowing economy, the fiscal score is lowered to -1.

Norway 2015: -1

From the 2015 Budget Summary:

> The estimated structural, non-oil deficit in 2014 equates to 5.8 per cent of mainland Norway trend GDP. The fiscal stance, measured by the change in the structural, non-oil deficit as a proportion of mainland Norway trend GDP, is estimated at 0.7 percentage point. This is 0.2 percentage point higher than anticipated last autumn. One reason for the increase is lower-than-expected use of oil revenues in 2013. The structural, non-oil deficit equates to 6.4 per cent of mainland Norway trend GDP, about ½ percentage point higher than in 2014. The use of funds from the Government Pension Fund Global in 2015 is anticipated to equal 3.0 per cent of the Fund capital at the beginning of the year.

According to the 2015 Article IV report (p.9):

> The moderate fiscal expansion this year is broadly appropriate in light of the expected economic slowdown due to the sharp and largely unanticipated decline in oil prices. The 2015 budget entails an expansionary fiscal stance with a non-oil structural deficit of 6.4 percent of trend mainland GDP. This is estimated to be equivalent to 2.6 percent of the value of the GPFG, much less than the full amount targeted under the fiscal rule (4 percent) but still implies a fiscal impulse of about 0.6 percentage point. In the medium term, a shift to a broadly neutral fiscal stance would be more appropriate on the basis of current projections. Should growth turn out weaker than projected in 2016, the authorities should allow automatic stabilizers to operate.

Given an additional fiscal impulse in 2015 to support the economy in the consequences of low oil prices, the fiscal score remains at -1.

Luxembourg

Luxembourg 2006: 1

The economy of Luxembourg was expanding but faced some structural challenges. Although the general government debt in 2006 amounted to only 7.5 percent of GDP, the authorities were worried about the forthcoming slowing of the financial sector. According to the 2006 Article IV report (p.3):

> The dominant financial sector has supported a steady rebound in economic activity. Growth is projected to remain healthy in the near term, but trend growth may decline as the rapid financial sector expansion may decelerate. The recovery notwithstanding, the fiscal deficit has widened to 2.3 percent of GDP in 2005, driven primarily by social expenditure growth, while unemployment has edged up to 4½ percent.

From the 2005-2006 Convergence Programme (p.13):

> The 2006 budget consolidation path has been prepared in conformity with the Stability and Growth Pact. The nominal deficit is reduced from 2.3% of GDP to 1.8% of GDP, i.e. a deficit reduction of 0.5%. The structural deficit decreases by 0.4%, from 2% of GDP in 2005 to 1.6% of GDP in 2006. This adjustment path only marginally deviates from the 0.5% benchmark value. However, this slight deviation

> from the 0.5% of GDP benchmark for the adjustment path can be fully justified by the fact that the 2006 output gap will remain negative and by the high level of public investment (5.5% of GDP in 2005 and 2006). These investments, most notably in the rail and road networks as well as in the construction of a new airport terminal, are enhancing the long-term growth potential of the Luxembourg economy. Regarding public revenues, the ratio between total revenue and GDP records a slight 0.2% of GDP decrease from 44.7% of GDP in 2005 to 44.5% of GDP in 2006. In nominal terms, revenues are expected to grow by 6.5% compared to 2005.

From the 2006 Article IV report (p.20):

> There was agreement that additional measures may be needed to reach the 2006 budget deficit target. The budget envisages a reduction in the general government deficit by ½ percent of GDP to 1.8 percent of GDP. Staff noted that the underlying expenditure measures were not well defined, and saw the deficit stabilizing rather than declining […]. The authorities responded that the deficit target could still be reached through a temporary slowdown in investment expenditures. They noted last year's unanticipated VAT refunds—which reached 1 percent of GDP largely due to a single company—were unlikely to be repeated.

Both IMF staff and the authorities agreed that the position of the public finances would benefit from a consolidation. Despite some disagreement about the measures to implement it, the fiscal score is 1 in 2006, indicating a modest fiscal tightening.

Luxembourg 2007: 1

From 2006-2007 Stability Programme (p.8):

> The general government budgetary situation reached a deficit in 2004 and remained at a deficit in 2005. In 2006, the combined deficit of the three sub-sectors is estimated at 1.5% of GDP. In April 2006, the Government and the social partners, meeting within the "Tripartite", reached an agreement on a set of measures to regain a balanced budgetary position as soon as possible and at the latest in 2009.
>
> The main budgetary consolidation measures adopted by the Government and the social partners are as follows:
>
> • Increase of effectiveness of public spending by reducing the relative share of current operating expenditures in total public expenditures and by limiting the taking on of new staff in the public sector.
>
> • Adjustment of the automatic indexation system leading to a slowing down o the "automatic" growth of a significant share of public expenditure.
>
> • Optimisation of Government investment spending, of which the relative share calculated in relation to GDP will nevertheless continue to be situated well above the average of the Member States of the European Union.

• Adjournment and staggering of adjustment of allowances and old-age pensions foreseen for 1 January 2007: allowances and pensions will be increased by 1% on 1 July 2007, followed by 0.9% on 1 July 2008.

• Increase of long-term care insurance contribution rate payable by the insured party, which on 1 January 2007 will increase from 1% to 1.4%, while freezing the government contribution in nominal terms.

• Increase of VAT rate from 12% to 15% for certain services from 1 January 2007 onwards.

• Increase of solidarity tax from 2.5% to 3.5% for households and from 4% to 5% for corporations from 1 January 2008 onwards.

Overall, the authorities realize the necessity to bring the budget to balance as soon as possible. They identified a consolidation strategy, which provides for at least a 0.5 percent of GDP annual reduction of the deficit in the following years. In 2007, the structural deficit was reduced by 0.8 percent of GDP and, therefore, the fiscal score remains at 1.

Luxembourg 2008: 0

The consolidation measures adopted in April 2006 combined with a renewed economic boom resulted in a return to a balanced budgetary position. This allowed the authorities to restore a neutral budget stance, which in the classification is described by a score of 0.

From the 2007-2008 Stability Programme (pp.13-14):

> In comparison with the estimate of the budget balance for the 2007 fiscal year, the budget balance presented in the draft budget for the 2008 fiscal year is down by 0.2% of GDP but remains largely positive. This reduction in the budget surplus can be explained mainly by the development of the revenue aspect of the draft budget, with public expenditure continuing to follow on the downward trend of the recent fiscal years. Indeed, according to the draft budget, the ratio between public revenues and GDP will undergo a reduction from 38.5% in 2007 to 37.8% in 2008. This development can be explained by the development of the taxes, the GDP share of which decreases from 24.4% to 23.6%. In terms of direct taxes, an adjustment to inflation of 6% of the personal income tax brackets will be carried out in 2008. Indeed, the personal income tax scale has not been adjusted to inflation since the 2001/2002 tariff reform.

Luxembourg 2009-2010: both 0

From the 2008-2009 Stability Programme:

> The 2009 draft budget presents a general government surplus of €427 million, i.e. 1.1% of GDP. The central government budget balance shows a deficit of 1.8% of GDP while the local government and social security budget balances continue to yield a surplus (0.2% of GDP and 2.7% of GDP, respectively). The economic context

governing the preparation of the 2009 draft budget is particularly difficult and uncertain. (p.15)

In the short term, taking into account the fragility of the economic recovery in 2010, the counter-cyclical fiscal policy started in 2008-2009 will be maintained during 2010. (p.9)

On 1 October 2009, Luxembourg notified to the European Commission a government budgetary surplus of 2.5% of GDP for 2008 and a foreseeable budget deficit of 2.2% of GDP for 2009. However, according to first estimates on the basis of latest available budgetary data at 31 December 2009, it turns out that the budget deficit in 2009 will be lower than expected and is now estimated at -1.1% of GDP. Thus, the economic crisis implied a deterioration of the general government budget balance of 3.6% of GDP or € 1,366 million, changing from a surplus of 2.5% in 2008 to a deficit of -1.1% in 2009. This deterioration is primarily due to the increase in public expenditure. (p.11)

The increase in the ratio between public expenditure and GDP of 4.9% between 2008 and 2009 is mainly due to the increase in the ratio between social transfers and GDP which goes up from 17.9% in 2008 to 20.7% in 2009, an increase of 2.8%. This development is largely explained by the consequences of automatic stabilisers, taking into account in particular the raise in public expenditure related to unemployment and short-time working. (p.12)

The increase in the public deficit from 1.1% of GDP in 2009 to 3.9% of GDP in 2010 can be explained on the one hand by a drop in the ratio between public revenues in terms of GDP of 2% (from 41.6% in 2009 to 39.6% in 2010) and on the other hand by 2009-2014 an increase in the ratio between public expenditure and GDP of 0.9% (from 42.6% in 2009 to 43.5% in 2010). (pp.12-13)

The budget for 2010 remains an anti-crisis budget and reflects the will of the Government to implement a counter-cyclical fiscal policy. It is thus characterised by a change in public expenditure (+6.1% in nominal terms), including the maintenance of a high level of public investment, whose growth rate will be above growth of nominal GDP (2.5%). (p.13)

Overall, the deficit expanded mainly due to cyclical factors, due to lower than projected revenues and the effect of automatic stabilisers. The authorities did not respond with a discretionary stimulus package, but slowed the consolidation down. The fiscal stance is described with the score of 0 in 2009-2010 as broadly neutral.

Luxembourg 2011: 1

The Government's budgetary objective is a balanced budget of the general government in 2014 at the latest. The successful implementation of this target implies a budgetary effort of about € 300-500 million per year [SK: 0.6-1 percent of 2010 GDP] during the period 2011-2014 to arrive at a total annual effort in 2014 close to € 1,600 million [SK: 3.2 percent of 2008 GDP]. (2008-2009 Stability Programme, p.15)

The budgetary consolidation will start in 2011 and deficit correction measures will consequently be taken for the first year of budgetary consolidation in 2011.

From the 2011 Article IV report (p.12):

> The 2011 budget has appropriately initiated fiscal consolidation. The budget targets cutting the deficit from 1¾ percent of GDP to about 1 percent, with the consolidation being predominantly expenditure-based. A cap on public investment to 2009 levels accounts for about ⅔ of the adjustment. On the revenue side, the budget includes measures directed at upper-income households and, to a lesser extent, corporations. Specifically, a new crisis tax of 0.8 percent on personal income has been levied on all households earning more than the minimum wage. Also, the solidarity tax and the top marginal personal income tax rate have been increased.
>
> While agreeing that fiscal consolidation was appropriate, the authorities were reluctant to allow automatic stabilizers to operate fully, should growth slow more than expected. Besides the negligible fiscal multipliers in a small open economic, political realities introduce an asymmetry in the cycle whereby it was exceedingly difficult to consolidate during an upswing. They stressed nonetheless their commitment to achieve a balance by 2014.

Overall, in 2011 the authorities are starting the process of consolidation. The rate of consolidation on international standards is relatively modest and the fiscal score is, therefore, 1.

Luxembourg 2012: 0

From the 2012 Stability Programme:

> In 2012, the general government deficit will increase from 0.6% of GDP in the previous year to 1.5% of GDP. The increase in deficit in 2012 can be attributed primarily to the development of public expenditure. […] (p.11)
>
> The budgetary consolidation measures have an impact of 1.2% of GDP per annum compared to a scenario based on unchanged policies. 2/3 of savings come from reductions in public expenditure and 1/3 involves tax increases. (p.4)
>
> In light of the state of public finances and taking into account the above-mentioned structural challenges, the Government adopted the broad guidelines of a medium-term budgetary strategy in April 2012. The objective of this strategy is to implement a series of budgetary consolidation measures in order to reduce the public deficit and thus to create a greater budgetary margin of manoeuvre to absorb possible negative shocks, while endeavouring to limit the negative effects of such a policy on the economic recovery. (p.9)

Due to the recession in the economy in 2012, the authorities allowed the automatic stabilisers to operate, and had a broadly neutral stance described by a fiscal score of 0. The authorities adopted the new medium-term budgetary strategy in April 2012. Under the programme the rate of consolidation was to amount to 1.2 percent of GDP in 2013-2014.

Luxembourg 2013-2014: 2 and 1

From the 2014 Stability Programme (p.12):

> In 2013 and 2014, the implementation of a series of budgetary consolidation measures has helped to stabilise the nominal general government deficit and to improve the underlying structural deficit. The impact of the measures adopted in 2013 amounts to 2.1% of GDP relative to a scenario of unchanged policies, while that of those proposed in 2014 amounts to 0.5% of GDP. Despite a slight deterioration in the structural balance in 2014, Luxembourg is expected to remain within its 2014 medium-term budgetary objective.

Also, a new medium term programme was adopted for 2015-2018.

> For the period 2015-2018 the government has set itself two main budgetary objectives in its governmental programme: i) to bring the structural balance back to the medium term budgetary objective of a +0.5% of GDP in 2018, and ii) to stabilise gross public debt at below 30% of GDP. The medium-term strategy is based in particular on the following actions:
>
> - an effort to consolidate €1.04 billion or 1.7% of GDP structurally and permanently relative to the trajectory under an unchanged policy scenario over the period 2015-2018, so as to ensure that the structural balance converges appropriately, in accordance with the rules of the SGP, with the medium-term budgetary objective of +0.5% of GDP;
>
> - a package of specific measures relating to VAT revenues: a 2% increase in the normal rate and intermediate rates is scheduled for 1 January 2015, with a budgetary impact on revenues of €350 million, or 0.7% of GDP.
>
> - an indicative trajectory of measures that the government will subsequently have to specify. For the purposes of this SGP update, this indicative trajectory is based on the assumption that efforts are concentrated exclusively on the expenditure side.
>
> Lastly, it should be noted that the reform of the pension system, which came into force on 1 January 2013, contributes to the viability of public finances by significantly reducing public expenditure relating to population ageing and hence also reducing implicit liabilities compared with a no-policy-change scenario. (Stability Programme 2014, pp.4-5)

The authorities proceeded with the implementation of the consolidation under the strategy adopted in April 2012. The fiscal stance is described by scores 2 and 1 in 2013 and 2014 respectively considering the size of the measures in each year.

Luxembourg 2015: 1

From the 2015 Article IV report (p.14):

> The 2015 Budget launches a multi year fiscal consolidation to address falling e-VAT revenues. Under a phased shift in EU taxation on e-commerce from domicile of seller

> to residency of purchaser as legislated in 2008, retained e-VAT revenue is set to more than halve in 2015, to about 1 percent of GDP, and halve again by 2018. In response, the authorities have raised VAT rates by 2 percentage points, expected to yield ½ percent of GDP in 2015 with the full impact kicking in from 2016, and have introduced a temporary personal income tax to balance the budget, set at ½ percent of income. After an expenditure review in 2014, some paring down of social spending is also to begin in 2015. Based on the authorities' macro framework, the budget targets a general government deficit of 0.2 percent of GDP in 2015, after a surplus of 0.6 percent in 2014. Based on staff's more conservative macro framework, the deficit for 2015 is projected at 0.5 percent of GDP, still consistent with the medium-term objective.

Overall, according to the IMF staff, the discretionary consolidation measures had an effect of about 1 ppt. on the 2015 Budget. The fiscal score is, therefore, 1.

3. Conclusion

This paper constructs a new database of fiscal measures taken by the governments of 20 OECD economies during 2006-2015. In this paper, the fiscal action is identified using a historical approach similar to that of Ramey and Shapiro (1998), Ramey (2011), Romer and Romer (2010), and Devries, Guajardo, Leigh, and Pescatori (2011). In particular, I examine policymakers' intentions and structural actions described in relevant policy documents.

This approach is useful because the classifications constructed by organizations such as OECD or IMF attribute an implausibly large proportion of the movement in structural balance to a deterministic component, producing a clear common trend in the cross-country dataset. This factual dataset presents a much more nuanced picture which is not as much distorted by the cycle. For example, in the United Kingdom, according to the IMF, the structural balance has always been in deficit in the aftermath of the financial crisis. In this dataset, however, we are able to capture that from 2011 the Coalition government opted for much larger-scale austerity measures than the Labour government.

4. General Data sources

1. The Stability and Convergence Programmes submitted to the European Commission up to 2010 can be found here:

http://ec.europa.eu/economy_finance/economic_governance/sgp/convergence/programmes/index_en.htm

From 2011, Stability and Convergence Programmes archives can be found here:

https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/stability-and-growth-pact/stability-and-convergence-programmes_en

Note: These archives also contain National Reform Programmes.

2. The archive of available Article IV Consultation reports is here:

http://archivescatalog.imf.org/DEFAULT.ASPX

3. OECD Economic Surveys can be found here:

http://www.oecd-ilibrary.org/economics/oecd-economic-surveys_16097513

4. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN COUNCIL: A European Economic Recovery Plan, at

http://ec.europa.eu/economy_finance/publications/pages/publication13504_en.pdf

5. Country-specific sources

Austria

Article IV Consultation 2006 (Preliminary Conclusions)

https://www.imf.org/en/News/Articles/2015/09/28/04/52/mcs121106https://www.imf.org/en/News/Articles/2015/09/28/04/52/mcs121106

United Kingdom

National Budget and Pre-Budget reports up to 2010:

http://webarchive.nationalarchives.gov.uk/20100407010852/http://www.hm-treasury.gov.uk/home.htm

From 2011:

National Budget and Pre-Budget reports from 2011:

https://www.gov.uk/government/organisations/hm-treasury

Canada

Budget documents:

https://www.fin.gc.ca/access/budinfo-eng.asp

Denmark

European Commission Working Paper 2011. Assessment of the 2011 national reform programme and convergence programme for DENMARK:

http://ec.europa.eu/europe2020/pdf/recommendations_2011/swp_denmark_en.pdf

Turkey

Medium-Term Fiscal Plans:

http://www.bumko.gov.tr/EN,2709/medium-term-fiscal-plan.html

28th Annual OECD Senior Budget Officials Meeting on Budgeting in Turkey:

http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=GOV/PGC/SBO(2007)6

Norway

National Budget Documents:

http://www.statsbudsjettet.no/Statsbudsjett-2006/English/

United States:

Congressional Budget Office reports:

https://www.cbo.gov/

Budget tables 2007

https://www.gpo.gov/fdsys/pkg/BUDGET-2007-BUD/pdf/BUDGET-2007-BUD-31.pdf

Italy:

Macroeconomic imbalances Country Report – Italy 2015

http://ec.europa.eu/economy_finance/publications/occasional_paper/2015/pdf/ocp219_en.pdf

Ireland:

Medium Term Fiscal Statements and Budget documents, including Summaries of Budget Measures:

http://www.budget.gov.ie/Budgets/2017/2017.aspx

6. Appendix

Table 3.1. Categorical variable describing the fiscal stance of the government.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria	-2	-1	0	-2	-1	1	1	0	0	0
USA	1	1	-1	-3	-3	-2	-1	2	2	1
UK	1	1	1	-2	-3	2	2	2	2	2
Germany	1	1	1	-2	-1	1	1	1	1	1
Italy	1	1	0	-1	0	2	2	2	0	0
Spain	0	0	0	-3	2	3	3	2	2	1
Greece	2	1	1	1	3	3	2	2	2	2
Denmark	0	0	0	-3	-2	0	-1	1	0	0
Belgium	-1	1	1	-2	-1	1	1	1	1	1
Netherlands	0	-1	-1	-2	-1	1	1	1	1	0
Canada	-1	0	0	-3	-3	1	1	1	1	0
Portugal	2	1	1	-1	1	2	2	2	1	1
France	1	0	0	-2	0	2	2	2	1	1
Ireland	-1	-1	0	3	3	3	3	3	2	2
Sweden	-1	-1	0	-2	0	0	-1	-1	-1	1
Switzerland	1	0	-1	-2	-1	0	0	0	0	0
Iceland	-1	-2	-1	3	3	3	1	0	0	0
Turkey	-1	1	-1	-2	1	-2	-1	-1	-1	1
Norway	0	-1	1	-3	-1	0	0	0	-1	-1
Luxembourg	1	1	0	0	0	1	0	2	1	1

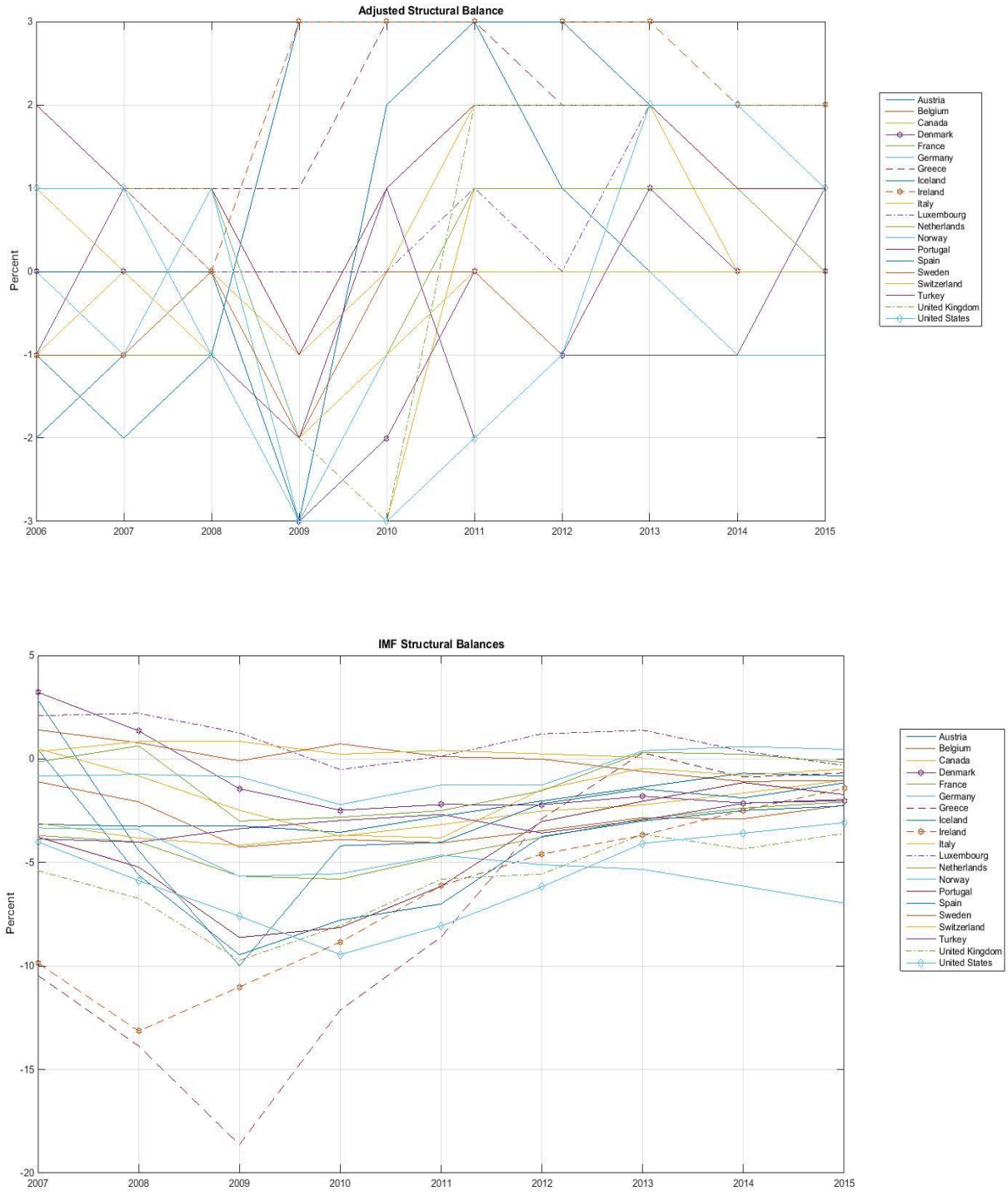


Figure 3.1 Structural balances in Entire Sample.

The first graph represents an adjusted discretionary stance. The second simply shows IMF data on the structural balances.

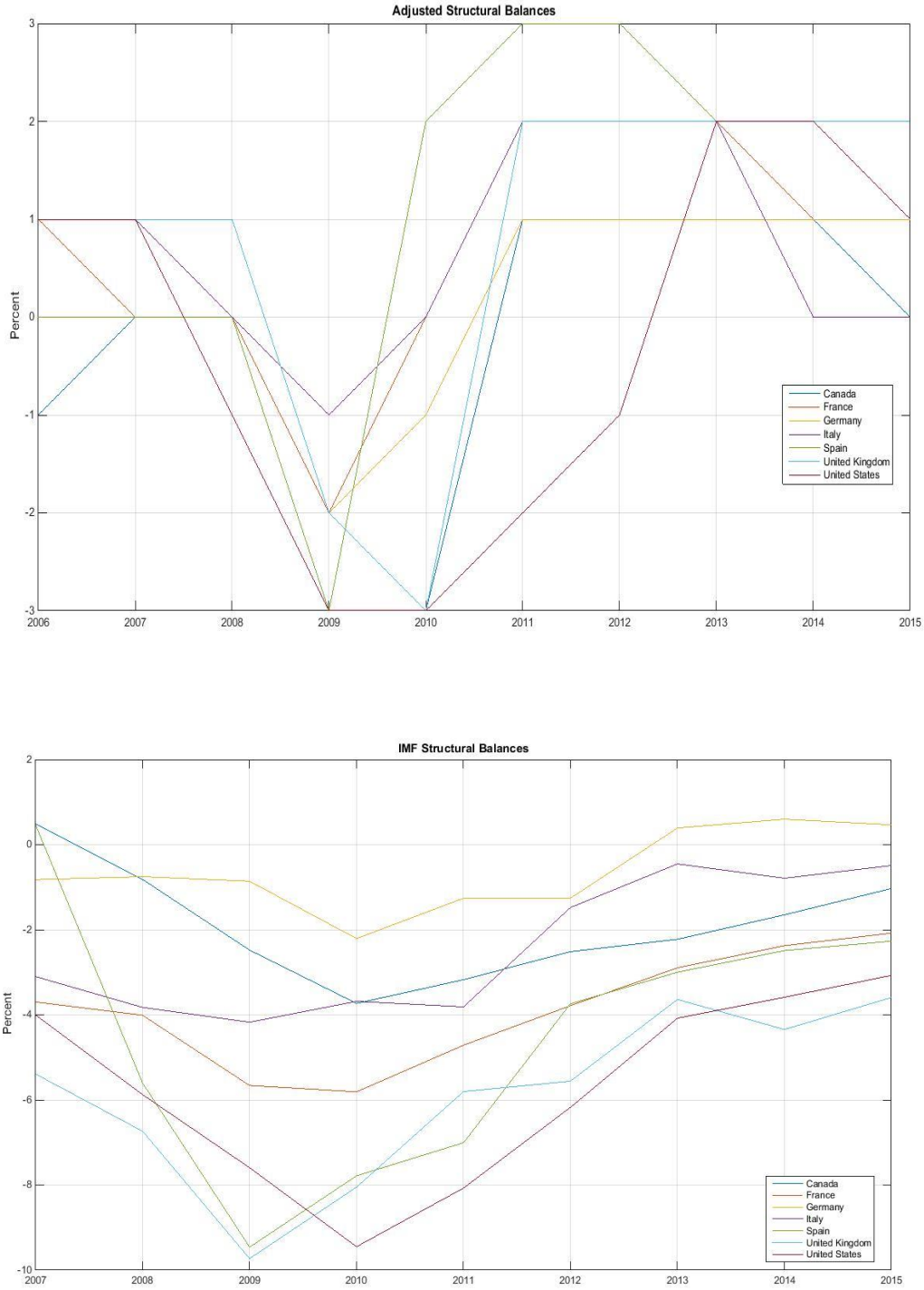
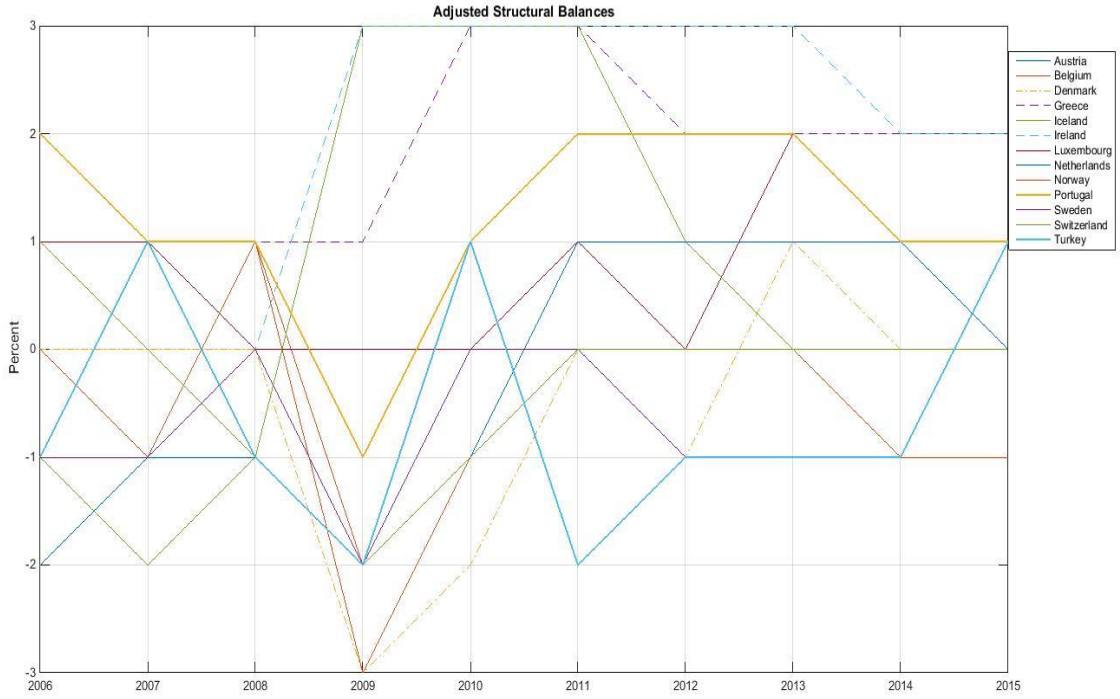


Figure 3.2 Structural balances in 7 Largest Countries of the Sample.

The first graph represents an adjusted discretionary stance. The second simply shows IMF data on the structural balances.



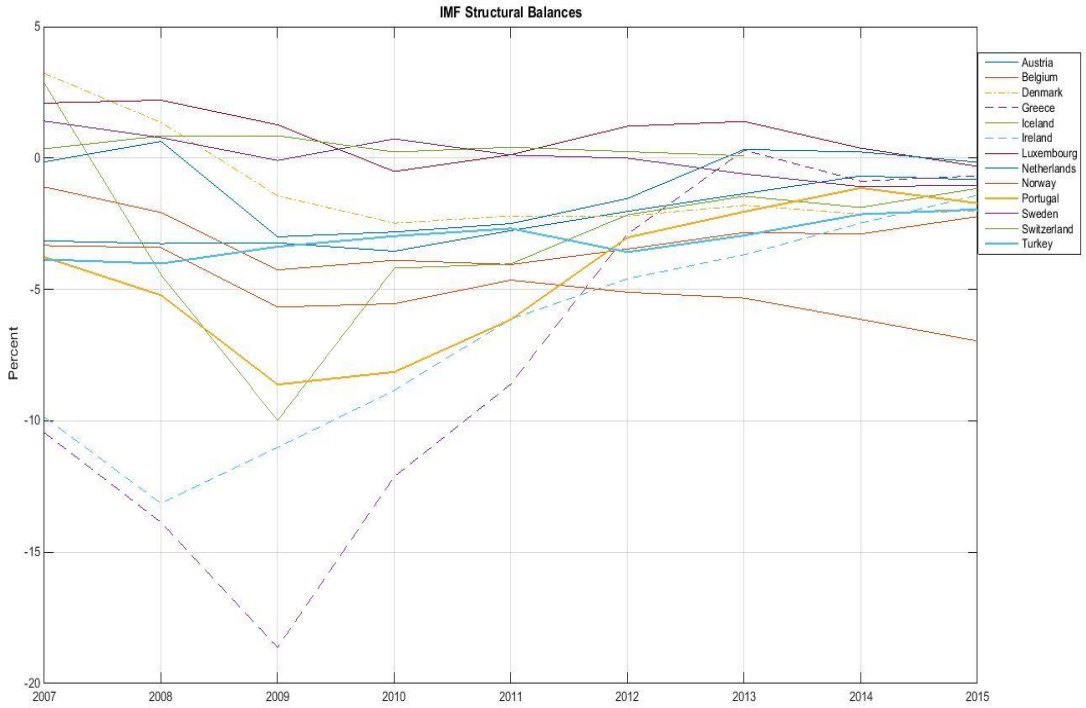


Figure 3.3 Structural balances in the other Countries

The first graph represents an adjusted discretionary stance. The second simply shows IMF data on the structural balances.

CHAPTER 4: Regime Switching Methods for DSGE models. A perspective on Financial Crisis and QE.

1. Introduction and Motivation

For almost thirty years, economists have been simulating and estimating constant parameter structural models using the US and international data. However, the assumption of parameter constancy may fail because the world is changing and some parameters of structural models may be unstable.

During the Great Moderation, the economic activity has become significantly less volatile in most developed countries. In the US, for example, the standard deviation of GDP growth averaged over four quarters during 1960-1984 was about triple from what it was from 1985-2015. This decline in volatility was widespread across the majority of sectors in most countries. Such a dramatic shift gave rise to one of most exciting debates in economics. Sims and Zha (2006) and Farmer et al. (2011) identified several competing economic reasons for the failure of the constant parameter framework to explain this development. One possibly most obvious explanation, which nevertheless, found much support in the economic literature, is that there occurred an abrupt break in the variance of structural shocks (Stock and Watson, 2003; Sims and Zha, 2006; Justiniano and Primiceri, 2008). Another view is that it happened due to breaks in the parameters of the private sector equations due to financial innovation (Bernanke, Gertler, and Gilchrist, 1999; Christiano, Motto, and Rostagno, 2008; Gertler and Kiyotaki, 2010). Finally, another popular view is that it happened because the policy rule followed in the 1970s was such that implied non-uniqueness of equilibria and hence vulnerability of the economy to "sunspot" fluctuations (Clarida, Gali, and Gertler, 2000; Lubik and Schorfheide, 2004; Davig and Leeper, 2007; Fernandez-Villaverde and Rubio-Ramirez, 2008; Christiano, Eichenbaum, and Rebelo, 2009).

As pointed out by Foerster (2014), another interesting discussion, which cannot be resolved in a constant parameter framework concerns Volcker disinflation era. During the 1970s, the US experienced significant macroeconomic volatility due to high and unstable inflation. In the early 1980s, the Federal Reserve under Paul Volcker as a new chairman raised nominal interest rates in an attempt to lower the average inflation rate and volatility. A constant parameter DSGE model fails to take into account that a subsequent decline in inflation was due to the monetary policy switch, possibly due to lower inflation target or an increased willingness to fight inflation deviations from the target (inflation response), or both.

Farmer et al. (2011) summarize the main competing views on the source of structural breaks. First, they occur due to the variance of structural shocks (Stock and Watson, 2003; Sims and Zha, 2006; Justiniano and Primiceri, 2008); second due to breaks in the parameters of the private sector equations due to financial innovation (Bernanke, Gertler, and Gilchrist, 1999; Christiano, Motto, and Rostagno, 2008; Gertler and Kiyotaki, 2010); third, due to breaks in the parameters of monetary and fiscal policy rules (Clarida, Gall, and Gertler, 2000; Lubik and Schorfheide, 2004; Davig and Leeper, 2007; Fernandez-Villaverde and Rubio-Ramirez, 2008; Christiano, Eichenbaum, and Rebelo, 2009). Markov Switching framework is attractive because it allows to endogenously determine which structural breaks are most likely to have occurred in the data.

The study of switching regimes dates back to the work of Quandt (1958), who introduced switching parameters into a regression model. Goldfeld and Quandt (1973) subsequently introduced the concept of the Markov chain into a regression model, which means that the probability of a

parameter switch to a different state depends only on the current state, and the probability of switching is governed by the state transition matrix. Markov switching models in economic time-series analysis were first introduced by Hamilton (1989) who applied them to autoregressive models of trend GDP with the goal to analyze the behaviour of business cycles. Hamilton (1989) used Goldfeld and Quandts (1973) Markov-switching regression in order to allow the parameters of the trend GDP model to switch between two regimes. He found that a regime switching model fits the data much better than simple ARMA models with positive coefficients at low lags.

Since then, reduced form Markov-switching models have been widely used to study economic problems in which there are occasional structural shifts in fundamentals. Filardo (1994), Hamilton and Lin (1996), Filardo and Gordon (1998) are amongst other influential studies of the business cycles using Markov Switching models. Engel and Hamilton (1990), Engel and Hakkio (1996) are amongst the studies of exchange rate behaviour, in particular during European Currency Exchange (EMS) system, where some long periods were characterized by extreme stability of exchange rates, while others were periods of extreme volatility. Markov switching models have been applied to various other fields, for example, Garcia and Perron (1996) analysed the real interest rate under regime shifts, while Schaller and van Norden (1997) used them to analyse stock market returns. Later Markov Switching models have been developed to incorporate possible switches in the conditional variance of regression models, and therefore, allowing for stochastic volatility. Melino and Turnbull (1990), Harvey, Ruiz, and Shephard (1994), Hamilton and Lin (1996) and Dueker (1997) are amongst most influential studies in this field.

An important step in the development of Markov Switching methods came when the researchers started to consider multivariate models, introducing so-called Markov Switching Vector Autoregressions (MS-VARs). According to Krolzig (1997), MS-VAR models as a Gaussian vector autoregressive process conditioned on an exogenous regime generating process are very closely related to state space models as well as the concept of doubly stochastic processes introduced by Tjøstheim (1986). The popularization of their use in economics, though, came only after the seminal work of Sims and Zha (2006). They came up with an efficient identification scheme for MS-VARs. MS-VARs are the closest relative of MS-DSGE models because they allow constructing multiple equation representations of an economy, which means that a researcher can think about potential spillover effects of regime switches from one series to another.

MS-DSGE model may be quite useful because it captures the fact that the structure of the economy changes over time and contains structural economic theory to account for anticipation effects. In essence, MS-DSGE models connect reduced form Markov-Switching literature with cross-equation restrictions from structural economic models.

This paper considers a Markov switching extension to a famous Gertler and Karadi (2011) financial intermediation DSGE model, which has a potential to uncover some of the interesting insights from the data in light of recent economic events.

The recent financial storm, which caused the Great Recession led to a drastic change in the conduct of monetary policy. Since the end of 2008, policy makers in many developed countries faced with an effective zero-lower bound on their key policy rates and had to consider other options to restore the growth. In particular, the central banks in the United States, United Kingdom and Eurozone used so-called unconventional policy measure, such as large-scale asset purchasing programmes (LSAP), dramatically expanding the size of their balance sheets. As a result, the economy found itself in an unprecedented environment, possibly different regime.

I solve and simulate a Markov-Switching Gertler and Karadi (2011) model that allows for stable and recession regimes, for the shifts in the parameters of monetary policy response and shifts in structural shock volatilities. In the modelled economy, the agents form their rational expectations about the probability of the financial crisis and policy response. The focus of the paper is to examine how the formation of those expectations influences banking sector, households and, therefore, policy outcomes under different regimes.

An important contribution of the paper is introducing a possibility of a switch to ZLB in the model. First, it makes the model more empirically relevant in light of the recent financial crisis. Second, it allows to describe how the possibility of visiting a ZLB regime influences the dynamics in non-ZLB regimes. As it turns out, omitting a possibility of a switch may lead to invalid inference even when the modelled regime prevails. The Bayesian estimation of the model using the quarterly US data allows to see to what extent the Markov Switching DSGE model with financial frictions matches the economic history.

The remainder of the paper proceeds as follows. Section 2 introduces the framework and discusses the methodology of Markov Switching Dynamic Stochastic General Equilibrium (MS-DSGE) models. It also reviews the solution methods as well as sufficient conditions for the determinacy and stability of the equilibrium. Section 3 introduces Markov Switching Gertler and Karadi (2011) model and emphasizes the features that can be important for the model dynamics. In Section 4, I summarize the results of model simulation and estimation, drawing conclusions about the economic dynamics in different regimes and discuss the policy implications. Finally, Section 5 concludes.

2. Framework and methodology

In the previous section, we have considered some empirical and policy questions that can be considered within the regime-switching framework. As it is clear, those models are potentially attractive, however, may be quite tricky. Therefore, many efforts have been directed towards solving them and making tractable for the subsequent analysis.

Regime switching DSGE model implies an environment in which the parameters of an already potentially nonlinear model switch between different states. Its special case, when transition probabilities are constant is referred to as Markov-Switching DSGE model. In such environment, economic agents form a rational expectation about the future of all economic variables conditional upon a possibility of regime shifts. This means that the agents know that the economic environment they live in may change dramatically. Here, I explain main existing methods for solution and perturbation of such models, pointing out their advantages and disadvantages. Apart from that, I emphasize equilibrium determinacy and stability conditions in the class of MS-DSGE models.

2.1 Literature review

In their seminal study, Lubik and Schorfheide (2003) have demonstrated how to partition the parameter space of linear rational expectation (LRE) models into two distinct and disjoint regions: one where exists unique determinate solution, and the other where there are multiple solutions driven by non-fundamental “sunspot” shocks.

First studies to extend the work of Lubik and Schorfheide (2003) to MS-DSGE models were Svensson and Williams (2005), Davig and Leeper (2006, 2007), Farmer, Waggoner and Zha (2008).

Svensson and Williams (2005) examine optimal and other monetary policies using Markov jump-linear quadratic (MJLQ) systems with regime switching and provide an algorithm for finding the optimal policy as well as solutions for arbitrary policy functions. In their baseline model, a central

bank minimizing its loss function faces constraints with both predetermined and forward-looking variables. The presence of forward-looking variables means that the problem is no longer recursive and it is not possible to use the global methods from control theory. Svensson and Williams (2005) applied the recursive saddlepoint method, which converts the model into recursive and allows the use of the algorithms for the value function and the optimal policy function. The main conclusion of their study is that in a regime-switching environment certainty equivalence no longer applies, so the policy makers should consider uncertainty seriously and opt for "distribution forecast targeting" rather than "mean forecast targeting".

Davig and Leeper (2007) consider fluctuating fiscal and monetary policy outcomes using a Markov-Switching DSGE model with nominal rigidities. They compute the solution using the monotone map method. This algorithm uses a discretized state space and requires a set of initial decision rules that reduce the system to a set of non-linear expectational first-order difference equations. The solution is a set of functions that map the minimum set of state variables into values for the endogenous variables. Davig, Leeper and Walker (2011) use the monotone map method approach to assess the implications of rising debt in an environment with a "fiscal limit." According to Gali's and Sims' comments, one of the issues with monotone map approach is that the global uniqueness of the solution has not been established in a rigorous way and applies to a quasi-linear system of the underlying MSRE model.

Farmer, Waggoner and Zha (2009) were able to extend the findings of Lubik and Schorfheide (2003) and to determine the partition of parameter space for forward-looking Markov-Switching Rational Expectation models, where there are no predetermined variables. They showed that the equilibria of MSRE models could be of two types; minimal state variable (MSV) equilibria and non-fundamental equilibria. Non-fundamental equilibria if it exists is a sum of MSV equilibrium and a secondary stochastic process. As shown in FWZ (2009), once MSV equilibrium is found a secondary stochastic process is easy to obtain.

Farmer Waggoner and Zha (2011) have been able to develop an efficient algorithm using Newton's method to find all MSV equilibria in the class of MSRE models, including those with lagged state variables.

However, Cho (2011) argued that the conditions of FMZ (2009) are difficult to examine in practice because the set of sunspot solutions has a continuum of members sharing the same functional form, and its dimension increases exponentially with the size of the model and the number of regimes. Also, the numerical algorithm of FMZ (2011) can identify indeterminacy if more than one solution is found to be stable. However, it is not known how many fundamental solutions exist for a MSRE model because of its inherent non-linearity, which means that determinacy cannot be identified.

Cho (2011) has laid out tractable methodological foundations for the solution, called forward method, as well as described sufficient conditions for determinacy and indeterminacy in the mean-square stability sense in general MSRE models with lagged endogenous variables. He showed that the forward solution is the unique stable equilibrium under determinacy, as well as provided the set of equilibria associated with the forward solution under indeterminacy.

Then he applied the methodology to a New-Keynesian model subject to regime switching in monetary policy to describe the partition of the parameter space and its influence on the determinacy of the system.

Perhaps most popular approach for solving MS-DSGE models is the one, which applies Markov Switching to the parameters of linearized DSGE models, using the methods developed by Farmer et

al. (2009, 2011) and Cho (2011). However, these solution techniques, as pointed out by Foerster et al. (2014), have two significant shortcomings of MSLRE. First, this approach begins with a system of linear rational expectations equations that have been obtained by linearizing equilibrium conditions as if the parameters of the underlying model were constant over time. Discrete Markov processes are usually added to certain parameters after this stage, which effectively assumes that agents were not aware of the switching structure of the model at a point of solving their optimization problem. Secondly, the MSLRE approach does not take into account higher-order coefficients in the approximation. Higher-order approximations are important not only because they improve the approximation accuracy but also allow to tackle some fundamental policy questions. For example, whether the time-varying volatility is the driving force of the fluctuations in the financial markets and business cycles and what it means for the welfare outcomes. Foerster et al. (2014) introduce a partition perturbation method for construction first-order and second-order approximations to the solutions of MSDSGE models, which are consistent with the original potentially nonlinear model.

The solution approach applied in this paper follows Maih (2015) and is more general then discussed above. In contrast to Foerster et al. (2014) in the derivation of higher-order perturbations, it allows for endogenous transition probabilities as well as for the anticipated events or shocks following Maih (2010) and Juillard and Maih (2010). In addition, this approach does not require partitioning of the switching parameters, allows for the possibility of multiple steady states and delivers the results of "partition perturbation" of Foerster et al. (2014) as a special case.

2.2 Solution of DSGE models

Model setup

As discussed in the literature review, the methodology for the solution of Regime Switching DSGE models is quite complicated and nuanced. However, so far much work has been conducted to facilitate this problem. In what follows I use Maih (2015) who developed an object-oriented toolbox RISE for MATLAB for the solution, simulation and estimation of Regime Switching DSGE models. In this section I explain the main features of this methodology as well as discuss the differences compared to the ones developed previously.

Probably most popular solution approach so far used in the literature is the one that starts out with a linear model and the applies a Markov switching to the parameters, like in Farmer et al. (2011) and Cho (2014). However, as discussed above, it is desirable to have the flexibility for the solution of some non-linear problems, avoiding a somewhat ad-hoc approach for introducing Markov switching parameters. Therefore, Maih (2015) starts out from positing the problem to solve:

$$E_t \sum_{rt+1=1}^{h} \pi_{rt,rt+1}(I_t)\tilde{d}_{r_t}(\upsilon) = 0 \tag{2.1}$$

Where E_t is the expectation operator, $\tilde{d}_{r_t}(\upsilon): \mathbb{R}^{n_\upsilon} \to \mathbb{R}^{n_d}$ is a $n_d \times 1$ vector of potentially non-linear functions of their argument υ, $r_t = 1,2,...,h$ is the regime prevailing at time t, $\pi_{rt,rt+1}(I_t)$ is the conditional on the information set I_t endogenous transition probability for switching from regime r_t to r_{t+1} at period t+1.

This model is a general Regime Switching DSGE model. However, for the rest of the exposition, we are going to deal with its special case when the transition probabilities are constant. This model is referred to as Markov-Switching DSGE (MS-DSGE) model.

The argument of the nonlinear function $\tilde{d}_{r_t}$ is defined as a $n_\upsilon \times 1$ vector:

$$\upsilon \equiv \left[b_{t+1}(r_{t+1})' \;\; f_{t+1}(r_{t+1})' \;\; s_t(r_{t+1})' \;\; p_t(r_{t+1})' \;\; f_t(r_{t+1})' \;\; p_{t-1}' \;\; b_{t-1}' \;\; \varepsilon_t' \;\; \theta_{rt+1}' \right]' \quad (2.2)$$

Where:

- s_t is a $n_s \times 1$ vector of static variables, which appear in the model only at time t.
- f_t is a $n_f \times 1$ vector of forward looking variables, which appear in the model both at time t and t+1.
- p_t is a $n_p \times 1$ vector of predetermined variables, which appear in the model both at time t and t-1.
- b_t is a $n_b \times 1$ vector of "both" variables, which appear in the model both with a lag and a forward looking component.
- ε_t is a $n_\varepsilon \times 1$ vector of shocks with $\varepsilon_t \sim N(0, I_{n^\varepsilon})$
- θ_{rt+1} is a $n_\theta \times 1$ vector of switching parameters appearing with a lead in the model.

Defining $d_{rt,rt+1} \equiv \pi_{rt,rt+1}(I_t)\tilde{d}_{r_t}$, the objective 2.1 becomes:

$$E_t \sum_{r_{t+1}=1}^{h} d_{r_t, r_{t+1}}(\upsilon) = 0 \quad (2.3)$$

Maih's (2015) methodology assumes that the agents have information for all or some of the shocks k periods into the future. This strategy of modelling "anticipated shocks" differs in many ways from the alternative "news shocks" approach. First, it allows for the discounting of future events, while in the "news shocks" the impact of shocks does not depend on the horizon they occur. Also, "anticipated shocks" are genuinely structural shocks unlike "news shock" which are simply iid shocks. The estimation of models with the "news shocks" requires additional variables to be declared as endogenous and enter the measurement equation, which makes model comparison infeasible because it requires similar set of observables. "Anticipated shocks" feature is especially attractive is that it allows for Bayesian Model comparison, because "anticipated shocks" are separated from the data.

Given the strategy for modelling shock, we include a perturbation parameter σ into the model. So, the $n_z \times 1$ vector of state variables is defined as follows:

$$z_t \equiv \left[p_{t-1}' \;\; b_{t-1}' \;\; \sigma \;\; \varepsilon_t' \;\; \varepsilon_{t+1}' \;\; \ldots \;\; \varepsilon_{t+k}' \right]' \quad (2.4)$$

Where $n_z = n_p + n_b + (k+1)n_\varepsilon + 1$.

General solution of the MS-DSGE model has the following form:

$$y_t(r_t) \equiv \begin{bmatrix} s_t(r_t) \\ p_t(r_t) \\ b_t(r_t) \\ f(r_t)_t \end{bmatrix} = \mathrm{T}^{rt}(z_t) \equiv \begin{bmatrix} S^{rt}(z_t) \\ P^{rt}(z_t) \\ B^{rt}(z_t) \\ F^{rt}(z_t) \end{bmatrix} \tag{2.5}$$

Where $y_t(r_t)$ is the $n_y \times 1$ vector of all the endogenous variables, and $n_y = n_s + n_p + n_b + n_f$. Unfortunately, the analytic solutions to 2.3 do not exist even in the case when $d_{rt,rt+1}$ is linear. Therefore, we have to rely on the perturbation techniques, which allow the approximation of the solution of type 2.5. Then it is possible to solve these approximated decision rules by inserting their functional forms into 2.3 and its derivatives.

Approximation

For the subsequent derivations, we define for all $g \in \{s, p, b, f\}$ an $n_g \times n_y$ matrix λ_g that select the solution of g-type variables in y or T . Also, $\lambda_x \equiv \begin{bmatrix} \lambda_p \\ \lambda_b \end{bmatrix}$ and $\lambda_{bf} \equiv \begin{bmatrix} \lambda_b \\ \lambda_f \end{bmatrix}$ are the selectors for p-b and b-f variables respectively. Also, for all $g \in \{p_{t-1}\ b_{t-1}\ \sigma\ \varepsilon_t\ \varepsilon_{t+1}\ \ldots\ \varepsilon_{t+k}\}$ a matrix m_g of size $n_g \times n_y$ ta hat selects the g-type variables in the state vector z_t .

In order to approximate the solution of MS-DSGE model which is the function of state variables, we have to start expressing all the variables in the system as functions of z_t .

Since both $b_{t+1}(r_{t+1})$ and $f_{t+1}(r_{t+1})$ appear in the objective function, we need to express z_{t+1} in terms of z_t . This is expressed as follows:

$$z_{t+1} = h^{rt}(z_t) + uz_t \tag{2.6}$$

$$h^{rt}(z_t) \equiv \left[(\lambda_x \mathrm{T}^{r_t}(z_t))' \quad (m_\sigma z_t)' \quad (m_{\varepsilon,1} z_t)' \quad \ldots \quad (m_{\varepsilon,k} z_t)' \quad (0_{n_\varepsilon * 1})' \right]' \tag{2.7}$$

And u is a $n_z \times n_z$ random matrix defined as:

$$u \equiv \begin{bmatrix} 0_{(n_p + n_b + 1 + k n_\varepsilon) * n_x} \\ \varepsilon_{t+k+1} m_\sigma \end{bmatrix} \tag{2.8}$$

Foerster et al. (2014) postulate a perturbation solution for θ_{rt+1} as:

$$\theta_{rt+1} = \bar{\theta}_{rt} + \sigma \hat{\theta}_{rt+1} \tag{2.9}$$

However, the most flexible way to deal with forward-looking parameters of switching regimes θ_{rt+1} is by defining auxiliary variables. This makes it easy to handle the cases when $\tau > 1$. Foerster's solution is just a special case of Maih's (2015) approach and can be applied when $\tau = 1$.

Given the fact that we have expressed all the variables of the system in terms of state variables z_t, we can redefine υ:

$$\upsilon \equiv \begin{bmatrix} \lambda_{bf} \mathrm{T}^{rt+1}(h^{rt}(z_t) + uz_t) \\ \mathrm{T}^{rt}(z_t) \\ m_p z_t \\ m_b z_t \\ m_{\varepsilon,0} z_t \\ \overline{\theta_{rt}} + \theta_{rt+1} m_\sigma z_t \end{bmatrix} \tag{2.10}$$

So, the objective becomes:

$$E_t \sum_{r_{t+1}=1}^{h} d_{r_t, r_{t+1}}(\upsilon(z_t, u)) = 0 \tag{2.11}$$

Now, as we have expressed the solution in terms of the vector of state variables, we are ready to perturb the solution using Taylor expansions of the objective function 2.11

The first step of perturbation is to choose an approximation point. In a constant-parameter DSGE model, the solution is usually approximated around the steady state, which essentially is an equilibrium to which the system converges in the absence of shocks. In a regime-switching environment, the choice is not so obvious. Maih (2015) discusses several approaches to select an approximation point. Here, we briefly discuss each of them.

1. **Approximation around the ergodic mean.** This is the approach outlined be Foerster (2013, 2014), and suggests to find a perturbation solution of the system around its ergodic mean. The ergodic mean is computed by solving the following:

$$d_{\bar{r}}(b_t,\ f_t,\ s_t,\ p_t, b_t,\ f_{t,}\ p_t, b_t, 0, \bar{\theta}) = 0 \tag{2.12}$$

Overall, all the components of the υ vector have been replaced by their ergodic means. The ergodic mean however need not be a resting point, or a point to which a system converges in the absence of shocks.

2. **Approximation around regime-specific steady states.** The system may not be stable at the mean in a certain regime, but if the system is at one of its regime-specific means, it will stay there in the absence of further shocks. Those means are found by solving the following:

$$\tilde{d}_{rt}(b_t(r_t),\ f_t(r_t),\ s_t(r_t),\ p_t(r_t),\ f_t(r_t),\ p_t(r_t), b_t(r_t), 0, \theta_{rt}) = 0 \tag{2.13}$$

The idea behind this approach is clear. For example, many inflation-targeting countries have come through the path of disinflation. So, moving from higher inflation regime with a higher inflation target, they move to a different regime with lower inflation levels and targets. The solution approximated around the ergodic mean can be at a level of inflation, which is implausibly high relative to recent observations, which can severely hinder the forecasting performance of MS-DSGE model. Therefore, we choose this type of approximation when solving Markov-switching Gertler & Karadi (2011) model.

3. **Approximation around an arbitrary point.** This approach can be useful in cases where one of the regimes persistently deviates from the steady state. This can be useful to describe

times of extreme instability. For a more detailed explanation of this method, refer to Maih (2015).

First-order perturbation

At first-order, the Taylor approximation of the solution takes the following form:

$$\mathrm{T}^{rt}(z_t) \simeq \mathrm{T}^{rt}(\bar{z}_{rt}) + \mathrm{T}_z^{rt}(z_t - \bar{z}_{rt}) \tag{2.14}$$

Having found an approximation point using one of the methods discussed, T_z^{rt} is the only unknown component of the approximation solution. In order to solve for it, one needs to take a derivative of 2.11 with respect to z. Using tensor notation, we arrive at:

$$\left[\breve{d}_{rt}\right]^i + E_t \sum_{rt+1}^{h} \left[d_{\upsilon}^{rt,rt+1}\right]_{\alpha}^{i} \left[\upsilon_z\right]_j^{\alpha} = 0 \tag{2.15}$$

Where $\left[d_{\upsilon}^{rt,rt+1}\right]_{\alpha}^{i}$ denotes the derivative of i^{th} row of d with respect to α^{th} row of υ and, $\left[\upsilon_z\right]_j^{\alpha}$ denotes the derivative of α^{th} row of υ with respect to j^{th} row of Z.

For subsequent derivations, we define $d_{g^q}^{rt,rt+1} \equiv \dfrac{\partial d^{rt,rt+1}}{\partial g^q}$ for g=s, p, f, b and q=0,+,-. These are the derivatives of the objective with respect to different types of variables, which appear as contemporaneous, leading or lags. Then a matrix on current period variables:

$$\mathrm{A}_{rt,rt+1}^{0} \equiv \begin{bmatrix} d_{s^0}^{rt,rt+1} & d_{p^0}^{rt,rt+1} & d_{b^0}^{rt,rt+1} & d_{f^0}^{rt,rt+1} \end{bmatrix} \tag{2.16}$$

And,

$$d\upsilon = \begin{bmatrix} d_{b+}^{rt,rt+1} & d_{f+}^{rt,rt+1} & \mathrm{A}_{rt,rt+1}^{0} & d_{p-}^{rt,rt+1} & d_{b-}^{rt,rt+1} & d_{\varepsilon^0}^{rt,rt+1} & d_{\theta+}^{rt,rt+1} \end{bmatrix} \tag{2.17}$$

Maih (2015) shows how to derive υ_z but it is of form: $\upsilon_z = a_z^0 + a_z^1 u$. One of the challenges to calculate υ_z as can be seen in 2.10 is to calculate h_z^{rt}. This is given by:

$$h_z^{rt} = \begin{bmatrix} (\lambda_x \mathrm{T}_z^{rt})' & m_\sigma' & m_{\varepsilon,1}' & \dots & m_{\varepsilon,k}' & 0_{n_z^2 * n_\varepsilon} \end{bmatrix}' \tag{2.18}$$

Finally, with all the expressions above, the problem reduces to finding T_z^{rt} from the equation below:

$$\sum_{rt+1=1}^{h} \begin{pmatrix} [d_{b+}^{rt,rt+1} \quad d_{f+}^{rt,rt+1}] \lambda_{bf} \mathrm{T}_z^{rt} h_z^{rt} + \mathrm{A}_{rt,rt+1}^{0} \mathrm{T}_z^{rt} + \\ [d_{p-}^{rt,rt+1} \quad d_{b-}^{rt,rt+1}] \begin{bmatrix} m_p \\ m_b \end{bmatrix} + d_{\varepsilon 0}^{rt,rt+1} m_{\varepsilon,0} + d_{\theta}^{rt,rt+1} \hat{\theta}_{rt+1} m_\sigma \end{pmatrix} = 0 \tag{2.19}$$

Importantly, $\mathrm{T}_{z,x}^{rt}$ and h_z^{rt} can be partitioned. So, if we define $\mathrm{T}_{z,x}^{rt} \equiv \begin{bmatrix} \mathrm{T}_{z,p}^{rt} & \mathrm{T}_{z,b}^{rt} \end{bmatrix}$, we arrive at:

$$\mathrm{T}_{z}^{rt} = \begin{bmatrix} \mathrm{T}_{z,x}^{rt} & \mathrm{T}_{z,\sigma}^{rt} & \mathrm{T}_{z,\varepsilon^0}^{rt} & \mathrm{T}_{z,\varepsilon^1}^{rt} & \dots & \mathrm{T}_{z,\varepsilon^k}^{rt} \end{bmatrix} \tag{2.20}$$

$$h_{z}^{rt} = \begin{bmatrix} \lambda_x \mathrm{T}_{z,x}^{rt} & \lambda_x \mathrm{T}_{z,\sigma}^{rt} & \lambda_x \mathrm{T}_{z,\varepsilon^0}^{rt} & \lambda_x \mathrm{T}_{z,\varepsilon^1}^{rt} & \dots & \mathrm{T}_{z,\varepsilon^k}^{rt} \\ 0_{1*n_x} & 1 & 0_{1*n_\varepsilon} & 0_{1*n_\varepsilon} & \dots & 0_{1*n_\varepsilon} \\ 0_{n_\varepsilon*n_x} & 0_{n_\varepsilon*1} & 0_{n_\varepsilon} & I_{n_\varepsilon} & \dots & 0_{n_\varepsilon} \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ 0_{n_\varepsilon*n_x} & 0_{n_\varepsilon*1} & 0_{n_\varepsilon} & 0_{n_\varepsilon} & \dots & I_{n_\varepsilon} \\ 0_{n_\varepsilon*n_x} & 0_{n_\varepsilon*1} & 0_{n_\varepsilon} & 0_{n_\varepsilon} & \dots & 0_{n_\varepsilon} \end{bmatrix} \tag{2.21}$$

Therefore, the problem can be decomposed into several small ones. Maih (2015) shows how to evaluate the impact of endogenous state variables, the impact of uncertainty and the impact of shocks. Here, we discuss only the algorithms that may be used to evaluate the former. In order to do that, we need to solve the following problem:

$$\mathrm{A}_{rt}^{0}\mathrm{T}_{z,x}^{rt} + \mathrm{A}_{rt}^{-} + \sum_{rt+1=1}^{h} \mathrm{A}_{rt,rt+1}^{+}\mathrm{T}_{z,x}^{rt+1}\lambda_x \mathrm{T}_{z,x}^{rt} = 0 \tag{2.22}$$

Where

$$\mathrm{A}_{rt}^{0} \equiv \sum_{rt+1=1}^{h} \mathrm{A}_{rt,rt+1}^{0}$$

$$\mathrm{A}_{rt}^{-} \equiv \sum_{rt+1=1}^{h} \begin{bmatrix} d_{p^-}^{rt,rt+1} & d_{b^-}^{rt,rt+1} \end{bmatrix}$$

$$\mathrm{A}_{rt,rt+1}^{+} \equiv \begin{bmatrix} 0_{n_d*n_s} & 0_{n_d*n_p} & d_{b^+}^{rt,rt+1} & d_{f^+}^{rt,rt+1} \end{bmatrix}$$

Note that in order to simplify the derivation of their solution algorithm, Farmer et al. (2011) assume that a forward-looking coefficient matrix is known in the current period: $\mathrm{A}_{rt,rt+1}^{+} = \mathrm{A}_{rt,rt}^{+}$. In our case we follow Cho (2014) who allowed for a more complicated case when $\mathrm{A}_{rt,rt+1}^{+} \neq \mathrm{A}_{rt,rt}^{+}$.

Now, we are going to discuss the algorithms to solve 2.22. Before Maih's (2015) contribution, there existed five main solution methods:

- The fixed point algorithm developed by Farmer et al. (2008);
- Svensson and Williams (2005)'s iterative algorithm;
- Farmer et al. (2011) algorithm based on Newton's method;
- Cho's (2014) forward solution;
- Foerster et al. (2014) approach which solves the system of quadratic equations as in 2.22 using Gröbner basis, which proves to be able to find all possible solutions of the system.

However, as discussed by Maih (2015) all first four methods suffer from the disadvantage that they may not find all possible solutions even when they exist. A more modern approach by Foerster et al. (2014), being a rigorously proven framework to find all possible MSV solutions, has a serious disadvantage of being too computationally demanding. This makes it hard to use it for solving modern DSGE models.

Maih (2015) develops two main algorithms. One of them is the functional iteration algorithms. It is very effective when solving large systems, and is often used to solve value functions in the dynamic programming. For a detailed description of this algorithm and for the proof of its convergence refer to Maih (2015).

A second approach which is used for the solution of our Markov Switching Gertler & Karadi (2011) model is based on the already mentioned Newton algorithm.

We define the function of the guess solution $\mathrm{T}_{z,x}$ as:

$$W_{rt}(\mathrm{T}_{z,x}) \equiv \mathrm{T}_{z,x}^{rt} + \left[\mathrm{A}_{rt}^{0} + \left(\sum_{rt+1=1}^{h} \mathrm{A}_{rt,rt+1}^{+} \mathrm{T}_{z,x}^{rt+1} \right) \lambda_x \right]^{-1} \mathrm{A}_{rt}^{-} \tag{2.23}$$

If the current guess $\mathrm{T}_{z,x}$ is not such that $W_{rt}(\mathrm{T}_{z,x}) = 0$ for $r_t = 1,2,...,h$ the guess needs to be improved. This is done by perturbing $\mathrm{T}_{z,x}$ by a factor Δ and then expanding into:

$$W_{rt}(\mathrm{T}_{z,x} + \Delta) = W_{rt}(\mathrm{T}_{z,x}) + \Delta_{rt} - \left(\sum_{rt+1=1}^{h} L_{x^+}^{rt,rt+1} \Delta_{rt+1} \right) L_{x^-}^{rt} + HOT \tag{2.24}$$

Where

$$L_{x^+}^{rt,rt+1} \equiv U_{rt}^{-1} \mathrm{A}_{rt,rt+1}^{+}$$

$$L_{x^-}^{rt} = -\lambda_x \mathrm{T}$$

The Newton algorithm ignores higher-order terms and attempts to solve for Δ_{rt} so that:

$$W_{rt}(\mathrm{T}_{z,x}) + \Delta_{rt} - \left(\sum_{rt+1=1}^{h} L_{x^+}^{rt,rt+1} \Delta_{rt+1} \right) L_{x^-}^{rt} = 0 \tag{2.25}$$

Where $\Delta_{rt} - \left(\sum_{rt+1=1}^{h} L_{x^+}^{rt,rt+1} \Delta_{rt+1} \right) L_{x^-}^{rt}$ is the Frechet derivative of W_{rt} at $\mathrm{T}_{z,x}$ in direction Δ_{rt}.

The solution of 2.25 can be obtained using a direct or iterative approach. For the solution of our model we employ the iterative approach mainly because the direct approach involves a cost of building a huge Kronecker product matrix and inverting it and therefore reduces the computation burden. For the details of the solution algorithm as well as guess initialization strategies the reader is referred to Maih (2015).

Generalizing results for higher-order perturbation

Higher order approximations are important because not only they increase the accuracy of the solution but they also allow tackling some important policy questions, such as the importance of uncertainty and time-varying volatility for shaping business cycles as well as welfare outcomes.

Generalizing the Taylor approximation of the solution to MS-DSGE model to the arbitrary order p, we arrive at:

$$\mathrm{T}^{rt}(z) \simeq \mathrm{T}^{rt}(\bar{z}_{rt}) + \mathrm{T}_{z}^{rt}(z_t - \bar{z}_{rt}) + \frac{1}{2}\mathrm{T}_{zz}^{rt}(z_t - \bar{z}_{rt})^{\otimes 2} + \ldots + \frac{1}{p!}\mathrm{T}_{z\ldots z}^{rt}(z_t - \bar{z}_{rt})^{\otimes p} \qquad (2.26)$$

Here, the unknowns are $\mathrm{T}_{z}^{rt}, \mathrm{T}_{zz}^{rt}, \mathrm{T}_{z\ldots z}^{rt}$. As we have discussed how to solve for T_{z}^{rt}, in a similar way one can solve for any $\mathrm{T}_{z\ldots z}^{rt}$ by taking a p-order derivative of 2.11, or (p-1)-order derivative of 2.15. Then, we have:

$$0 = E_t \sum_{rt+1=1}^{h} \left\{ \sum_{l=1}^{p} \left[d_{\upsilon^{(l)}}^{rt,rt+1} \right]_{\alpha_1,\alpha_2\ldots\alpha_l}^{i} \sum_{c \in M_{l,p}} \prod_{m=1}^{l} \left[\upsilon_{z|c_m|} \right]_{j(c_m)}^{\alpha_m} \right\} \qquad (2.27)$$

Where:

- $M_{l,p}$ is the set of all partitions of the set of p indices with class l. In particular, $M_{l,p} = \{\{1,2,\ldots,p\}\}$ and $M_{p,p} = \{\{1\},\{2\},\ldots,\{p\}\}$
- $|.|$ denotes the cardinality of a set
- c_m is the m-class of partition c
- $j(c_m)$ is the sequence of j's indexed by c_m

2.3 Determinacy and Stability of the Solution

Here, we discuss the determinacy of the solution, which is the existence and uniqueness of a stable minimum state variable solution.

The stability conditions for constant-parameter DSGE models do not apply in a Markov Switching case. Farmer et al. (2009) were first to discuss them, when they introduced an engineering concept of Mean-square stability (MSS) into the literature.

The Markov switching system is mean-square stable when its first and second moments converge to well-defined limits. Formally,

a) $\lim_{t\to\infty} E_0\left[x_t\right] = \mu$

b) $\lim_{t\to\infty} E_0\left[x_t x_t^{'}\right] = \Sigma$

If in addition to those two conditions the process is bounded, then the process is referred to as boundedly stable. Formally, I also has to meet the following condition:

$\| x_t \| < N$, for all t, where $\|.\|$ is any well-defined norm.

For Markov-switching systems usually, there are many instances in which the system maybe unstable in one or more of the regimes. However, as long as this regime does not occur too frequently, the state variables will still converge to its finite first two moments and a well-defined ergodic distribution. Bounded stability though simply rules out such regimes. Most practical applications assume unbounded errors and there is no known necessary and sufficient conditions for stability a stronger bounded stability case. Due to those reasons MSS became a standard for checking stability in Markov switching systems.

As shown by Gupta et al. (2003) and Costa (et al. 2005, chapter 3), a necessary and sufficient condition for MSS is that the matrix Υ has all its eigenvalues inside the unit circle:

$$\Upsilon \equiv (Q \otimes I_{n_x^2 * n_x^2}) \begin{pmatrix} \lambda_x \mathrm{T}_{z,x}^1 \otimes \lambda_x \mathrm{T}_{z,x}^1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \lambda_x \mathrm{T}_{z,x}^h \otimes \lambda_x \mathrm{T}_{z,x}^h \end{pmatrix} \tag{2.28}$$

Where Q is the constant transition probability matrix.

When the transition probabilities are allowed to be endogenous, the notion of MSS no longer applies. Also, even in constant probability case, there is no theorem implying that the stability of first-order perturbation implies the stability of higher orders.

3. Model

In this section, we proceed to characterize the basic characteristics of Gertler & Karadi (2011) model with Markov switching parameters.

3.1 Households

There is a continuum of identical households, who consume, save and supply labour. Within each household, there are two types of members: a fraction f of bankers and (1-f) of workers. An individual can switch between the professions. In particular, a banker in the current period stays banker in the next period with a probability θ. In total, $(1-\theta) f$ bankers exit each period and become workers. The same number of workers randomly become bankers keeping relative proportions the same. The households provides its new bankers with some start-up funds.

The households preferences can be described by the following utility function:

$$\max E_t \sum_{t=0}^{\infty} \beta^t \left\{ \ln(C_t - hC_{t-1}) - \frac{\chi}{1+\varphi} L_t^{1+\varphi} \right\} \tag{3.1}$$

Subject to the budget constraint

$$C_t = W_t L_t + \Pi_t + \mathrm{T}_t + R_t B_t - B_{t+1} \tag{3.2}$$

The household chooses consumption C_t, the number of working hours L_t and one-period risk-free government bonds to buy B_{t+1}. They receive income from workers earning the wage W_t, receive a share of net profits from ownership of both financial and no-financial firms Π_t and receive payments from bonds maturing this period $R_t B_t$. T_t are lump sum taxes.

3.2 Financial Intermediaries

Private intermediation

Financial intermediaries play an important role in Gertler & Karadi (2011) model. They are meant to capture the entire banking sector, i.e. both commercial and investment banks. First, they lend funds obtained from households to non-financial firms. Second, they engage in maturity transformation

because they hold long-term assets which they fund with short term liabilities (in addition to their equity).

An intermediary j uses the amount of its net worth N_{jt} and the deposits obtained from the households B_{jt+1} to fund the financial claims or assets S_{jt} with a relative price Q_t. This gives the following balance sheet constraint:

$$Q_t S_{jt} = N_{jt} + B_{jt+1} \tag{3.3}$$

Over time, the banker's net worth evolves as the difference between the earnings on their assets and interest payments on the households' deposits:

$$N_{jt} = R_{kt+1} Q_t S_{jt} - R_{t+1} B_{jt+1} = R_{kt+1} Q_t S_{jt} - R_{t+1}(Q_t S_{jt} - N_{jt}) = (R_{kt+1} - R_{t+1}) Q_t S_{jt} + R_{t+1} N_{jt} \tag{3.4}$$

Bankers' participation constraint requires the positive expected discounted spread $(R_{kt+1} - R_{t+1})$:

$$E_t \beta^i \Lambda_{t,t+1+i} (R_{kt+1} - R_{t+1}) \geq 0, i \geq 0 \tag{3.5}$$

Where $\beta^i \Lambda_{t,t+1+i}$ is the stochastic discount factor.

And the banker's expected terminal wealth is equal to:

$$V_{j,t} = \max E_t \sum_{i=0}^{\infty} (1-\theta)\theta^i \beta^{i+1} \Lambda_{t,t+1+i} N_{jt+1+i} \tag{3.6}$$

Up to the point when $\beta^{i+1} \Lambda_{t,t+1+i} (R_{kt+1} - R_{t+1})$ is positive, the bankers will want to indefinitely expand their assets by borrowing additional funds from households. To limit their ability to do so, Gertler & Karadi (2011) introduced moral hazard into the model: at the beginning of each period a banker can divert a fraction λ of available funds back to its own household. The cost of doing so is the risk that the depositors can force the intermediary into bankruptcy by recovering the remaining fraction $(1-\lambda)$ of assets. Therefore, for households to be willing to supply funds to intermediaries the following incentive compatibility constraint must hold:

$$V_{jt} \geq \lambda Q_t S_{jt} \tag{3.7}$$

We can also express V_{jt} as follows:

$$V_{jt} = \nu_t Q_t S_{jt} + \eta_t N_{jt} \tag{3.8}$$

With

$$\nu_t = E_t \left\{ (1-\theta)\beta \Lambda_{t,t+1} (R_{kt+1} - R_{t+1}) + \beta \Lambda_{t,t+1} \theta x_{t,t+1} \nu_{t+1} \right\} \tag{3.9}$$

$$\eta_t = E_t \left\{ (1-\theta) + \beta \Lambda_{t,t+1} \theta z_{t,t+1} \eta_{t+1} \right\} \tag{3.10}$$

Where $x_{t,t+i} \equiv Q_{t+i}S_{jt+i}/Q_tS_{jt}$ and $z_{t,t+i} \equiv N_{jt+i}/N_{jt}$ are the growth rates between t and t+i in assets and in net worth respectively. The variable ν has the interpretation of the expected discounted marginal gain to the banker of expanding assets by a unit. η is the expected discounted value of having another unit of N, holding S constant.

If the constraint 3.7 binds, then we have:

$$Q_tS_{jt} = \frac{\eta_t}{\lambda - \nu_t} N_{jt} = \phi_t N_{jt} \tag{3.11}$$

Where ϕ is the ratio of privately intermediated assets to equity, which we will refer to as the (private) leverage ratio.

In perfect markets ν is zero but the agency problem puts a cost on expanding assets. The greater the ν, the higher is the opportunity cost of diverting funds. The constraint binds if $0 < \nu < \lambda$ else the franchise value of the intermediary always exceed the gain from diverting funds. In equilibrium though, under reasonable parameter values, the constraint always binds within a local region of a steady state.

None of the components of ϕ_t depends on firm-specific factors, meaning that each individual banker faces the same constraint. So, the total private intermediary assets equal to:

$$Q_tS_t = \phi_t N_t \tag{3.12}$$

The net worth of the entire banking sector consists of the net worth of existing bankers and of the new bankers:

$$N_t = N_{et} + N_{nt} \tag{3.13}$$

The equation of motion for the net worth of existing bankers is given by:

$$N_{et} = \theta\left[(R_{kt} - R_t)\phi_{t-1} + R_t\right]N_{t-1} \tag{3.14}$$

The intuition behind this equation is quite clear. Here, $\left[(R_{kt} - R_t)\phi_{t-1} + R_t\right]$ is the rate of return amplified by the leverage ϕ_{t-1} and θ is the fraction of surviving bankers from t-1 to t.

As already mentioned, the household supply its new bankers with start-up funds. In particular, with $\omega/(1-\theta)$ of the value of the remaining net worth of the banking sector. So, the net worth of newly entered bankers is given by:

$$N_{nt} = \frac{\omega}{(1-\theta)}(1-\theta)Q_tS_{t-1} = \omega Q_tS_{t-1} \tag{3.15}$$

Where $(1-\theta)Q_tS_{t-1}$ is the remaining net worth of the banking sector after the exit of bankers.

Combining 3.13, 3.14 and 3.15 gives the equation of motion for the net worth of the private intermediary firms:

$$N_t = \theta\left[(R_{kt} - R_t)\phi_{t-1} + R_t\right]N_{t-1} + \omega Q_t S_{t-1} \tag{3.16}$$

Government Policy

So far in the presentation of the model we have ignored the role of the government.

Now, we introduce the central bank which is willing to facilitate lending by purchasing the assets on top of those intermediated by the private sector. Let $Q_t S_{gt}$ be the value of assets intermediated with the government support, and $Q_t S_{pt}$ be the privately intermediated assets. Then, the total value of intermediated assets $Q_t S_t$ is equal to:

$$Q_t S_t = Q_t S_{pt} + Q_t S_{gt} \tag{3.17}$$

Let the fraction of total assets intermediated by the government be ψ_t, so we have:

$$Q_t S_{gt} = \psi_t Q_t S_t \tag{3.18}$$

Unlike private sector financial sector, the government intermediation does not involve moral hazard problems so there is no agency conflict which hinders its borrowing from the households. Other words, the central bank is not balance sheet constrained. However, the government intermediation involves an efficiency cost of τ for every unit of assets supplied, reflecting the ideas that the government is not as efficient in identifying investment opportunities as the private intermediaries and the problem of growing government debt.

Substituting into 3.17 equations 3.12 and 3.18, we have:

$$Q_t S_t = \phi_t N_t + \psi_t Q_t S_t = \frac{\phi_t}{1-\psi_t} N_t = \phi_{ct} N_t \tag{3.19}$$

The central bank intervenes the economy by manipulating ψ_t according to the following feedback rule:

$$\psi_t = \kappa E_t\left[(\log R_{kt+1} - \log R_{t+1}) - (\log R_k - \log R)\right] + \varepsilon_\psi \tag{3.20}$$

Where $(\log R_k - \log R)$ is the steady state premium and a positive feedback parameter κ.

The shock to the credit policy follows the following rule:

$$\varepsilon_\psi = \rho_\psi \varepsilon_{\psi,t-1} + \sigma_\psi \eta_\psi \tag{3.21}$$

According to this rule the central bank increases the fraction of publicly intermediated assets ψ_t above its steady state value ψ when it expects the growth in the stochastic spread, which has two effects on the economy. First, by purchasing assets it increases the amount of credit available to the real sector of economy. Second, it shapes expectations by changing the expected path of future short rates.

Additionally, a central bank can operate using conventional nominal interest rate rule, which is given by:

$$i_t = \rho_i i_{t-1} + (1-\rho_i)(\kappa_\pi \pi + \kappa_{\hat{y}} \hat{y}) + \sigma_i \varepsilon_i \tag{3.22}$$

Where π and $\hat{y}$ are inflation and the output gap respectively. The smoothing parameter ρ_i lies between 0 and 1.

The government balances its budget according to the following rule:

$$G + \tau \psi_t Q_t K_{t+1} = T_t + (R_{kt} - R_t) B_{gt-1} \tag{3.23}$$

Where capital evolves as follows:

$$K_{t+1} = \xi K_t + I_{nt} \tag{3.24}$$

And government bonds B_{gt-1} finance total government intermediated assets $\psi_t Q_t S_t$.

According to 3.22, the government finances government consumption G and expenditures on financial intermediation $\tau \psi_t Q_t K_{t+1}$ from lump sum tax receipts T_t and from financial intermediation profit $(R_{kt} - R_t) B_{gt-1}$.

3.3 Non-Financial Firms

Intermediate good producers

Now, we introduce the production side of the economy of Gerler & Karadi (2011) model. Competitive non-financial firms produce intermediate goods that are eventually sold to retail firms.

Intermediate good producers acquire capital using the funds obtained from issuing equity claims S_t, equal to the number of capital units K_{t+1}, and selling the claims to intermediaries. The price of those claims is equal to the price of a unit of capital Q_t, the market value of which is determined endogenously. So, the value of claims is $Q_t S_t$, and the value of capital acquired is equal to $Q_t K_{t+1}$. Therefore, we have:

$$Q_t K_{t+1} = Q_t S_t \tag{3.25}$$

Using the acquired capital K_t and labor L_t, the firm produces output Y_t. The production function is given by:

$$Y_t = A_t (U_t \xi_t K_t)^\alpha L_t^{1-\alpha} \tag{3.26}$$

Where A_t denotes total factor productivity; U_t is the varying capital utilization rate; and ξ_t denotes the quality of capital.

The equations of motions for the exogenous drivers of the business cycle follow AR (1) process:

$$A_t = \rho_a A_{t-1} + \sigma_a \varepsilon_{a,t} \tag{3.27}$$

$$\xi_t = \rho_\xi \xi_{t-1} + \sigma_\xi \varepsilon_{\xi,t} \tag{3.28}$$

Where $\varepsilon_{a,t}$ and $\varepsilon_{\xi,t}$ are standard normally distributed TFP and capital quality shocks respectively.

Capital depreciates depending on the capital utilization rate $\delta(U_t)$.

Firms earn zero profits state by state, it pays ex post return to capital to the financial intermediary. The return to capital is given by:

$$R_{kt+1} = \frac{\left[P_{mt+1}\alpha \frac{Y_{t+1}}{\xi_{t+1}K_{t+1}} + Q_{t+1} - \delta(U_{t+1}) \right] \xi_{t+1}}{Q_t} \tag{3.29}$$

Capital producing firms

At the end of period t, competitive capital producers acquire used capital from intermediate good producers and then this repair depreciated capital and sell new capital back to intermediate good producers. The value of the new unit of capital is Q_t which is endogenously chosen by capital producers. For the capital producers' problem, we refer the reader to Gertler & Karadi (2011) model.

Importantly, the capital accumulation equation is given by:

$$I_{nt} = I_t - \delta(U_t)\xi_t K_t \tag{3.30}$$

Where I_t is the gross capital created; I_{nt} is the net capital created and $\delta(U_t)\xi_t K_t$ is the quantity of capital refurbished.

As it is clear from equation 3.26, ξ_t enters the part with the existing capital stock, so a negative shock to ξ_t effectively destroys the existing capital.

Retail firms

Final output Y_t is the composite of mass of retail firms indexed by $f \in [0,1]$, that use intermediate output as its sole input. So, the final output is given by:

$$Y_t = \left[\int_0^1 Y_{ft}^{\frac{(\varepsilon-1)}{\varepsilon}} df \right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{3.31}$$

From cost minimization problem of consumers of final goods:

$$Y_{ft} = \left(\frac{P_{ft}}{P_t}\right)^{-\varepsilon} Y_t \tag{3.32}$$

$$P_t = \left[\int_0^1 P_{ft}^{1-\varepsilon} df \right]^{\frac{1}{(1-\varepsilon)}} \tag{3.33}$$

Retail firms just repackage the goods bought from the intermediate producers at price P_{mt} and set retail prices. Retail firms, however, face Calvo price stickiness. In particular, a firm is able to freely readjust the price with probability $(1-\gamma)$. With probability γ, they stick with the previous period priced indexed by the rate of inflation. Given the price rigidity, the retailers solve the following profit maximization problem and choose the optimal price P^*:

$$\max E_t \sum_{i=0}^{\infty} \gamma^i \beta^i \Lambda_{t,t+i} \left[\frac{P_t^*}{P_{t+i}} \prod_{k=1}^{i} (1+\pi_{t+k-1})^{\gamma_p} - P_{mt+i} \right] Y_{ft+i} \tag{3.34}$$

Where $\beta^i \Lambda_{t,t+i}$ is the stochastic discount factor and γ_p is the measure of price indexation.

The role of price rigidities is particularly important at times of financial crisis. Financial crisis may cause lower intermediate output and lower demand from households. In perfectly flexible price setting, there would occur an immediate reduction in prices. With sticky prices, though, some firms may be unable to re-optimize immediately, which means that the aggregate output will be lower than under flexible prices.

This completes the model. Now, we turn to the discussion of regime switching in the parameters of the model.

3.4 Regime Switching Summary

In this section we introduce regime switching to the core model. In particular, we introduce the parameters that switch between different regimes according to a Markov process to the capital quality process (equation 3.28) and to the credit policy feedback rule (equations 3.20 and 3.21).

The equation governing the capital quality process takes the following form:

$$\xi_t = \rho_\xi(s_t)\xi_{t-1} + \sigma_\xi \varepsilon_{\xi,t} \tag{3.35}$$

This functional form allows for the switches in the persistence $\rho_\xi(s_t)$, where s_t is the prevailing state of the Markov process.

The equations governing credit policy take the following form:

$$\psi_t = \kappa(s_t) E_t \left[(\log R_{kt+1} - \log R_{t+1}) - (\log R_k - \log R) \right] + \varepsilon_\psi \tag{3.36}$$

$$\varepsilon_\psi = \rho_\psi(s_t)\varepsilon_{\psi,t-1} + \sigma_\psi \eta_\psi \tag{3.37}$$

Here, the central bank is allowed to respond to the expected spread movements with the feedback parameter $\kappa(s_t)$. The sensitivity of the central banks response to spread and the persistence of the feedback rule shock are governed by the prevailing regime.

Additionally, the persistence of a shock to the feedback rule is also subject to regime switch, which reflects the idea that the central bank may wish to dispose of its purchased assets (when $\rho_\psi(s_t)$ is low) or keep the size of their portfolio at the level close to the previous period (when $\rho_\psi(s_t)$ is close to 1).

An assumed economy might be in three different regimes: a so-called 'crisis' regime, a 'recovery' regime and a no-crisis 'normal' regime and. Agents form their rational expectations being aware of the regimes characteristics as well as the transition probability matrix.

The 'crisis' regime is characterized by the low persistence of capital quality process. This means that a large fraction of the existing capital is destroyed. Due to lower mean of capital quality, less output is expected to be produced and more investment at expense of consumption is required to restore capital. Additionally, the central bank uses unconventional monetary policy when crisis occurs. In particular, it aggressively responds to the expected stochastic premium changes with κ set at a high level and therefore expands the size of its balance sheet.

When the crisis ends, the economy moves to the 'recovery' regime, the persistence of the capital quality process comes back to normal. The central bank doesn't intervene with asset purchases, but still doesn't sell off its assets keeping the size of the balance sheet stable. Other words, they let the economy recover without exposing it to further shocks. So, the central bank sets $\kappa = 0$ and $\rho_{\psi} = 1$.

A no-crisis 'normal' regime features high persistence of the capital quality process, which means that agents should expect ξ_t to be relatively close to the level of the previous period. They do not purchase assets on the open market, setting $\kappa = 0$. Also, if they have a portfolio of assets, that were purchased during the crisis, other words, $\psi_{t-1} > 0$, they also gradually sell-out the assets with $\rho_{\psi} \in [0,1)$.

We assume the following transition probability matrix associated with the instantiated regimes, which elements are $p_{i,j} = \Pr(s_{t+1} = j \mid s_t = i)$[4]:

$$T = \begin{pmatrix} 1 - p_{C,N} - p_{C,R} & p_{C,N} & p_{C,R} \\ p_{N.C} & 1 - p_{N.C} - p_{N,R} & p_{N,R} \\ p_{R,C} & p_{R,N} & 1 - p_{R,C} - p_{R,N} \end{pmatrix} \tag{3.38}$$

4. Empirical results

4.1 Calibration

I, now, discuss the results of the calibration of the regime-switching Gertler & Karadi (2011) model, which is solved using Newton's method based on Maih (2015). Table 1 specifies the choice of calibrated parameter values of the baseline regime-switching model. Most of the parameter values are identical to those chosen by Gertler & Karadi (2011) in their calibration of a constant-parameter model.

As in the original Gertler & Karadi (2011) model, we choose conventional values for discount factor β, the steady state depreciation rate δ_c, the capital share α, the elasticity of substitution and steady state share of investment and government expenditure. The habit parameter h, the elasticity of marginal depreciation with respect to utilization rate ς, the inverse elasticity of net investment to the price of capital η_i, the relative utility weight of labor χ, the Frisch elasticity of

[4] A more detailed explanation of the transition probability matrix can be found in appendix.

labor supply φ^{-1}, the price rigidity parameter γ and the price indexation parameter γ_p are all chosen in accordance with the estimates of Primiceri (2006). The Taylor rule (3.39) parameters, shock standard deviations as well as parameters specific to financial intermediaries, are chosen in accordance with Karadi's appendix.

Here, we explain the impulse responses of the major endogenous variables to the shocks of the model, which imply significant differences across the regimes of the model. We, therefore, concentrate on capital quality and central bank portfolio shocks and do not cover technology, government expenditure and bankers net worth shocks.

Crisis experiment

The crisis is initiated by a one standard deviation decline in capital quality disturbance $\varepsilon_{\xi,t}$, equivalent to about 5 percent deviation from the steady state. Due to a regime-switching persistence $\rho_{\xi}(s_t)$ in equation 3.35, the shock has heterogeneous effects in different regimes on the capital quality measure ξ_t. During the "crisis," the persistence of the capital quality process is set at a low level. This reflects a lower mean effect of the capital quality and higher volatility during "crisis." Therefore, an individual shock is quickly absorbed, with all effects nullified within 4 quarters. During the recovery regime, the shock is way more persistent, and it dies out only after about 20 quarters. And, finally, in the normal regime the capital quality shock has a once-for-all effect due to $\rho_{\xi}(s_t)$ close to one.

There is also a second-round effect of the shock. Due to the leverage ratio constraint, the weakening of intermediary balance sheets induces a drop in asset demand, asset prices Q and investment I. With a shock to asset prices, the value of equity and collateral diminish, depressing business activity. Additionally, the bankers start diverting more funds from projects to their households. The amplification of the effects occurs due to the leverage, ϕ, which jumps dramatically upon shock occurrence and initiates financial accelerator.

After the shock, the central bank steps in and lowers the nominal interest rate which is sufficient to reduce the real interest rate. Additionally, after an initial downturn caused by "capital flight," the stochastic return on risky assets, R_k, starts to increase. It means that after the shock, the stochastic premium grows significantly.

During the crisis regime, the central bank is ready to respond to stochastic premium movements and to step in with unconventional measures in monetary policy. They start buying assets, increasing the size of their balance sheet, ψ. Such a coordinated response of the monetary authorities ensures that the capital quality shock during the 'crisis' regime has a very short-lived effect.

In other two regimes, the central bank is not reacting to the stochastic spread movement which means that the size of their portfolio remains unaffected. Therefore, the effects in 'recovery' and 'normal' regimes are similar in nature. Due to the higher persistence of the shock in the 'normal' regime, the consequences of the shock are most significant in this regime. Intuitively, this is because in this regime the agents and central bank and are not prepared to offset the effects of this shock with central bank policy stance being least accommodative to face the shock.

After about 4 quarters of depressed investment during 'recovery' and after 6 quarters in 'normal' regime, as a consequence of a jump in stochastic premium, the investment starts picking up. Also, despite a quite persistent decline in wages, the labour supply starts growing as the income effect

outweighs the substitution effect. It all means that the asset prices, output growth, and inflation start recovering. The main difference between 'recovery' and 'normal' regimes is that during the former regime, the bankers net worth N start recovering relatively quickly after the initial shock, whilst during the latter N drops permanently. This is probably one of the main reasons why firms are unable to increase wage rates and restore their capital stock, which means a significant permanent decline in consumption and welfare.

Central bank asset purchases

This shock is initiated by a one standard deviation shock to the central bank portfolio disturbance η_{ψ}, which boosts the value of the central bank's portfolio, ψ_t (see eq. 3.20) by about 7 percentage points. In the basic calibration, we assume no cost for the central bank to engage in financial intermediation activity and set $\tau = 0$.

The persistence of the shock varies across regimes. The shock is most protracted during the 'recovery' regime. During this regime, the central bank seeks to maintain the size of their portfolio, acquiring assets to substitute the securities maturing in the current period. During "normal" regime, the central bank gradually sells-off assets from its portfolio. And during the 'crisis' regime, the central bank only responds to the premium fluctuations and does not hold a permanent portfolio due to $\rho_{\psi}(s_t) = 0$.

Generally, the shock may be interpreted as a boost in demand for market securities. Therefore, the asset price measure Q and bankers net worth N both grow. The banking projects become more attractive, so the incentive to divert funds, λ , reduces. As a result, investment and output grow, which causes an improvement in wage, consumption and welfare.

Additionally, due to the reduction in the leverage, the firms are able to increase their borrowing, which drives the risk-free interest rate up, driving the premium down and inflation up. It forces the central bank to increase its benchmark nominal interest rate. In 'normal' and 'crisis' regimes this is sufficient to normalize the spread and cool down the stock market, which means that the effects of the intervention gradually vane. During the recovery regime, the market participants anticipate that the policymakers are not going to eject stimulus for a long period. Therefore, they keep borrowing and investing in risky assets despite the central bank's intervention. This is similar to the recent experience in the US where the stock market rally continued as the investors kept investing in stocks despite gradual rate spikes. Also, during the 'recovery' over 3 quarters aftershock, the labour supply grows as the substitution effect tends to outweigh the income effect. This all ensures an increase in output, of magnitude more than 2 percent of GDP after 12-18 quarters after the shock.

4.2 Calibration of a model with a possibility of the Effective-Lower-Bound

In this section, I calibrate the same model as before, with an exception that now the policy rule assumes a probability of the economy being in the regime with the Effective-Lower-Bound.

$$i_t = ZLB_t \times 0 + (1 - ZLB_t)\rho_i i_{t-1} + (1-\rho_i)(\kappa_\pi \hat{\pi} + \kappa_y \hat{y}) + \sigma_i \varepsilon_i \qquad (4.1)$$

Where ZLB_t is an indicator variable which takes a value of 1 if the economy is in ELB, and 0 if not.

It means that apart from the transition probability matrix T defined in the previous section, we now define another Markov chain transition matrix:

$$Q = \begin{pmatrix} 1-p_{L,S} & p_{L,S} \\ p_{S,L} & 1-p_{S,L} \end{pmatrix} \tag{4.2}$$

Where $p_{L,S}$ is the probability of transition from the ZLB regime at time t to a stable at $t+1$. $p_{S,L}$ is the probability of transition from the stable regime at time t to ZLB at $t+1$. Other terms denote probabilities of staying in prevailing at time t regimes.

Now, the new transition probability matrix becomes $T \otimes Q$. In this model, the total number of regimes is six, because it is entirely plausible to assume that the policymakers may force the interest rate to zero in any state of the economy. This might be the case of their interpretation of the output gap or simply due to political reasons.

Allowing for an occasionally binding zero-lower-bound constraint in DSGE models is becoming increasingly important as recent economic history has two main examples with this type of problem and strikingly different economic outcomes. First, Japan in the 90s experienced a deflationary scenario with a very weak economic growth during the so-called "lost decade." Second, the United States during the recovery after the Great Recession, where policymakers with help of unconventional measures managed to restore economic growth.

A possibility of visiting a ZLB regime means that policymakers may face a problem first discussed in a seminal paper by Benhabib, Schmitt-Grohe and Uribe (2001) about the perils of Taylor rules. The essence of it is that when the Taylor rule takes into account the ZLB constraint, the interest rate setting becomes a convex function of inflation. This necessarily implies a multiplicity of equilibria in the economy with one regime where inflation is close to its targeted level, and where the interest rates respond more than one-to-one to inflation. The other of the regimes, however, is such that it includes low or potentially negative inflation and low or zero interest rate as well as passive response to inflation. When inflation rate falls, the nominal rate is not decreased more than one-for-one due to the ZLB, and when inflation rate rises, the nominal rate is not increased more than one-for-one because inflation is well below its target. The existence of the second local equilibrium also implies the existence of a large number of trajectories originating arbitrarily close to initial inflation target that leads to the steady state with low inflation. This state of the economy is characterized by decelerating inflation dynamics when the central bank is unable to bring about the government's goal to stabilize inflation and output. This is commonly referred to as a situation of "liquidity trap."

Here, I describe the impulse responses to the abovementioned capital quality and asset purchases shocks in six regimes: normal, crisis and recovery, each with and without binding ZLB constraint. As it turns out, the results change both qualitatively and quantitatively quite substantially as the agents incorporate the probability of a switch in a ZLB variable when forming their rational expectations.

Crisis experiment

The crisis is initiated by a one standard deviation decline in a capital quality measure, which falls by 5 percentage points. Zero-Lower-Bound, of course, does not affect the persistence of the shock, which means that the most protracted effect is going to be in the normal regime and least noticeable in a 'crisis' regime. Overall, the response of the system to this shock is qualitatively quite similar to the previous case with some minor exceptions. There are, however, some quantitative differences, which are worth mentioning.

As in the previous calibration, a second-round effect of the shock is due to the leverage ratio constraint. A shock induces a drop in asset demand, asset prices Q and investment I. The drop in

asset prices and, hence, investment is not as sharp as in the previous calibration. If the expected interest rate is lower, consumers prefer investments to savings because of the lower discount rate of future returns. Apparently, this is the reason why in binding ZLB regimes Q and I drop less than in non-binding ZLB regimes. Additionally, more stable asset prices and investment might be a consequence of a different nature of inflation expectations. In the calibration without the ZLB, the capital quality shock was generating deflation under all of the regimes, whereas now the shock is not moving inflation too far away from the steady state.

In ZLB regimes the policymakers are unable to manipulate interest rates in response to the shock. In response to the capital quality shock, the central bank bears in mind a possibility of a switch to the ZLB regime and in other regimes is also not responding by cutting the policy rate. This happens due to the fact that the central bank assigns a non-zero probability of visiting the ZLB regime and wants to keep some more room in response to future shocks if they occur.

With a negative shock to asset prices, the value of equity and collateral diminish, which adversely affects business activity. As before, the bankers start diverting more funds from projects to their households. Compared to a model without a possibility of ZLB, though, the divert fraction λ spikes immediately after the shock, but the effects die out quicker. This is because of the lower expectation of the interest rate, where agents start to realize that investment might be a good opportunity to store their earnings, which increases the marginal gain from expanding assets and, hence, increases the opportunity cost of diverting assets. Also, since the investment is more attractive than in a model without ZLB, the leverage ϕ increases even more.

The presence of the ZLB also affects the tradeoff between savings and consumption. The consumption drops, but around 30 percent less than in the previous calibration, which is, of course, positive for wages and welfare.

Central bank asset purchases

This shock is caused by a one standard deviation shock to the central bank portfolio disturbance η_{ψ}, which boosts the value of the central banks portfolio, ψ_t by about 7 percentage points. The behavior of the central bank with respect to asset purchases in response to this shock is the same as in the previous calibration. During the 'crisis' regimes, they aggressively respond to stochastic spread movements, but quickly sell out assets from the portfolio. During the 'recovery' regimes, they do not respond to new information regarding the spread but they try to keep the size of their portfolio constant. During the 'normal' regimes, they just gradually sell out assets from their portfolio. As it appears, allowing for the possibility of visiting the zero-lower bound has some very significant implications on the response of the system.

A shock, which essentially is a boost in demand for the market securities, makes asset prices Q, bankers net worth N and stochastic risk premium (Rk-R) grows. Strikingly, though, in the presence of a possibility to switch to ZLB, the incentive to divert funds spikes quite dramatically after the shock. As a result, unlike in the previous calibration, there is no observed growth in the private investment, and inflation expectations remain mostly unchanged. Additionally, whereas without ZLB, the central bank tries to close the positive output gap by raising interest rates, now they only do that in the 'normal' regime. In the 'crisis' and 'recovery' regimes they actually cut rates, trying to stimulate the economy using this instrument as well.

The consumers respond quite differently across the regimes. In the 'normal' regimes households indeed increase the consumption of real goods. There seems to be a stark difference between the

consumer's response in ‘recovery’ regimes depending on whether ZLB constraint binds: if it does not bind, they increase consumption quite dramatically and if it does bind they, actually, even cut their consumption slightly. Finally, in the “crisis no ZLB” regime, the households do not change their consumption in response to asset purchases by the central bank; in the “crisis ZLB” regime households react to the asset purchases as a sort of negative signal, which suggest that the low interest rate and inflation steady state may prevail for longer and actually cut their consumption. This “signaling” channel appears to be fundamental for the response of the system as a whole. It appears that in ‘crisis’ and ‘recovery’ ZLB regimes, asset purchases actually do not have any positive influence on the economy, leading to deflation as well as output and welfare losses. This signaling channel has already been analyzed in the literature. In their seminal paper, Hayashi and Koeda (2014) analyzed the two-equation new Keynesian model of Eggertsson and Woodford (2003) of the severity of the zero lower bound and showed that with a positive monetary shock the economy is automatically sent to the liquidity trap and when the monetary shock is set to zero a favourable equilibrium re-emerges.

It seems to be much more plausible to model the asset purchasing shock allowing for the possibility of visiting a zero-lower bound. Whereas in the previous calibration, the central bank was perceived as a benign “helicopter” that may drop money into the economy and solve all the aggravating problems, this clearly is not the case here. Even in the non-binding ZLB regimes, the effect of the asset purchases was bounded by 1 percentage point boost in nominal GDP, whereas before the model predicted that in the recovery regime it might be as high as 3 percentage points.

Overall, in previous calibration the asset purchases shock was interpreted as something that is going to push the output gap into the positive territory, now the dynamics is far more complicated. As it seems, when there is a possibility of visiting ZLB, the agents interpret the observed expansion of the central bank's balance sheet size as a signal that the economy might be close to the low interest rate and inflation steady state, which makes the efforts of the authorities far less successful.

It seems that policymakers in Japan during the “lost decade” were not able to engineer an exit from the liquidity trap, which meant that the economy was stuck in the binding ZLB regimes. The recent experience of the United States, the United Kingdom and Europe were more favorable in a sense that those countries were able to escape from the deflationary scenario. Although that scenario wasn't as seamless as the one considered in the previous calibration, the response of the system was more alike in the scenario with the non-binding ZLB constraint.

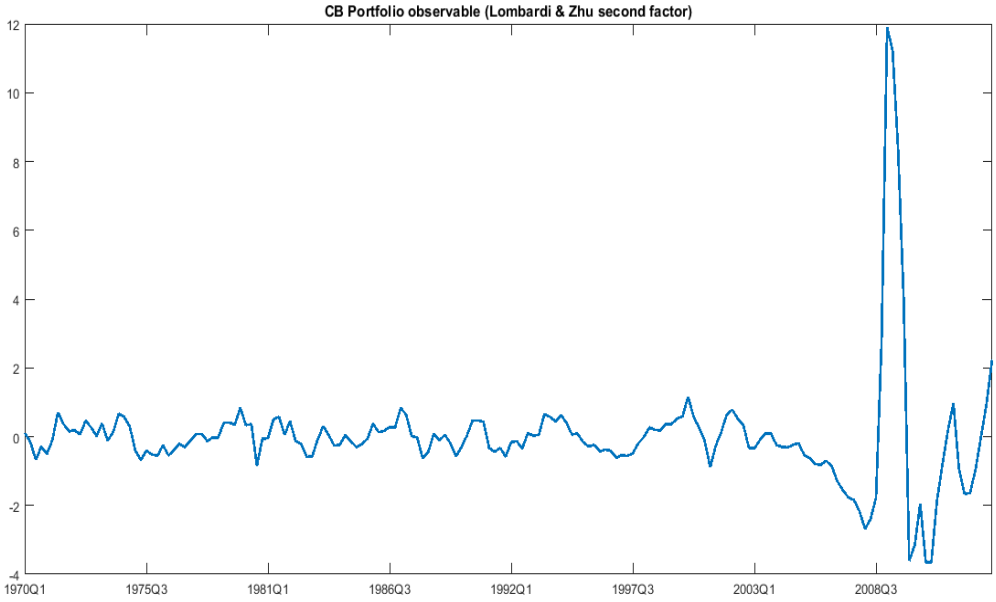
A key consideration, as Bullard (2010) argues, is whether the asset purchases are considered permanent or temporary by the private sector. Since base money can be as easily removed from the banking system as they can be added, it is essential if the central bank can gain the credibility for the idea to continue on asset purchases until the policy objectives were met. This is where the outcome of the recent financial crisis has been influenced by the so-called “forward guidance,” where the pledges such as Mario Draghi’s “whatever it takes” promise, undoubtedly had an impact on agents expectations.

4.3 Estimation

The model is estimated using the quarterly US data for the period 1970:1 to 2013:4. The model includes six observable variables: output, consumption, working hours, inflation, nominal interest rate and central banks portfolio. The data on first five variables used in estimation correspond to the dataset used in the estimation of Smets and Wouters (2007).

One of the main challenges is to pick a reliable gauge of the central bank's portfolio, ψ_t. The present utilizes Lombardi & Zhu (2014) dataset, who attempted to construct a shadow policy rate by constructing a dynamic factor model. We make use of their second factor, which captures most of the US monetary aggregates and Fed's portfolio measures. In order to achieve the stationarity of time series, the data are logged and first differenced.

Here is the plot of the observable variable used to measure central bank's portfolio:



As can be seen in the figure, the series is relatively stationary before the shock in 2008:2, when the portfolio almost exploded caused by Target Asset Repurchasing Programme (TARP) and round one of quantitative easing programme. The shock was followed by a few quarters of mild portfolio rebalancing before the start of the second round of large-scale asset purchasing programme.

The structural equations are appended by six structural shocks (technology, capital quality, government expenditure, net worth, interest rate, central banks portfolio), the standard errors of which are denoted (σ_a, σ_ξ, σ_g, σ_{Ne}, σ_i, σ_ψ) respectively. Measurement equations also accompanied with respective measurement errors.

Choice of priors and estimation details

The whole estimation procedure is computationally intensive, for the detailed description of it the reader is referred to Maih (2016). Briefly, due to the presence of unobservable variables the filtering procedure, similar to Kim and Nelson (1999b), is applied to compute the likelihood and track possible histories of regimes. Then, stochastic search optimization routines are applied in RISE toolbox to estimate the mode. For a given parameter draw, the model steady state is computed. In case, the steady state can be solved, the perturbation solution is computed using Newton's algorithm developed by Maih (2014). If the solution is found, then it is checked for the determinacy using Mean Square Stability (MSS) criteria.

These steps ensure finding the mode and takes about 30 hours of computational time. As the likelihood of the model is computed, then is combined with the prior distribution of parameters in

order to obtain the functional form of the posterior distribution. In order to draw from the resulting distribution, we need to apply Markov Chain Monte Carlo (MCMC), in particular, Metropolis-Hastings algorithm, as it proved itself most suitable for DSGE models.

The sampling of the posterior distribution is not an easy exercise, and in complicated models, the density may be multimodal, which means that there is no guarantee that the optimization routines will successfully find the global peak of the posterior distribution of the parameters. Identification may be a concern also due to the fact that the identification theory has not been extended to regime switching rational expectation models and such tests as in Iskrev (2010) are not available.

Table 2 lists the choice of priors for the parameters as well as their posterior means and standard deviations of the estimated baseline regime-switching model.

In total, we estimate 16 parameters since their estimates are crucial to how the financial intermediation mechanism as well as policy response work in the model. These also underline the importance of regime switching framework in Gertler and Karadi (2011) model.

The prior parameter distributions are in line with Smets and Wouters (2007). The standard errors of the error terms are assumed to follow an inverse gamma distribution. The persistence parameters of all shock processes, the autoregressive coefficients and response to spread parameters follow a beta distribution. The initial values are chosen to be identical to the calibrated values. Upper and lower quantiles of the parameter distributions are chosen on the basis of the DSGE literature consensus.

We begin by investigating the coefficients of regime-switching parameters. The 'crisis' regime coefficients chosen according to the theoretical framework explained in the calibration section, in particular, we set: $\rho_{\xi}(1)=0.2;\kappa(1)=7$; $\rho_{\psi}(1)=0$. The coefficients of 'normal' and 'recovery' regimes are estimated, using relatively loose prior assumptions, with initial values and means centered near their respective calibration values. The transition probability matrix $T\otimes Q$ is assumed exogenous, with the same parameter values as in the calibration.

Judging by the results of the estimation, it seems that the assumed parametrization of regimes used in calibration does not properly describe the data generating process. We estimate that the capital quality persistence is estimated to be roughly similar in the 'normal' and 'recovery' regimes, with estimates of 0.589 and 0.541 respectively. Similarly with calibration, the response to spread parameter is estimated to be very close to zero in the 'normal' regime. The central bank also quite aggressively sells off assets from the portfolio, setting $\rho_{\psi}(2)=0.254$.

In the 'recovery' regime, the central bank noticeably responds to spread with $\kappa(3)=0.509$ and gradually unloads assets from its portfolio with $\rho_{\psi}(3)=0.67$. The suggested estimates contrast our prior 'theoretical' assumption that the central bank in the recovery regime does not respond to spread and keeps the size of portfolio constant. In fact, they do respond to spread although far less aggressively than in 'crisis' and keep the portfolio size quite persistent relative to other two regimes. Besides as the estimates of standard deviations suggest, the more protracted effects are coming from the portfolio, government purchases and technology shocks, whilst standard deviations of capital quality and net worth shocks are significantly lower.

Our estimated parameters are affected by the Mean Square Stability requirement. In isolation, a ZLB regime is not a stable regime, but in combination with a possibility to switch back to the inflation targeting state, there exist parameter values that result in a stable system.

Table 3 lists the remainder of the model parameters, which are calibrated. Their values are exactly the same as in the previous full calibration.

Smoothed regime probabilities

Figure 5 describes the smoothed filtered regime probabilities of the estimated Markov Switching Gertler and Karadi (2011) model. We find that the parameters of capital quality and of the central bank's unconventional response have not remained constant during the sample period (from 1970 to 2014). At particular points in time, the economic conjuncture looked similar to "Crisis," 'normal' or 'recovery' regimes, which the model seems to identify.

Here, we draw historical parallels between the economic events in the US and the smoothed probabilities of our estimated regime switching model. The 1970s started in a 'normal' regime during so-called Post-World War II economic expansion before the Western World was hit by the 1973-1975 recession. Among the causes were the fall of the Bretton Woods system and 1973 oil crisis. This economic period in the United States is referred to as a period of stagflation when high unemployment and high inflation persisted simultaneously. Following the abandoned anchor to gold, the money supply increased quite significantly, which resulted in the expansion of Fed's portfolio. This is a consequence of the transitions to the 'recovery' regime in 1972:2, 1972:4 and 1974:1-1975:3. The monetary policy rule remained loose for some time after the recession, which is why 'recovery' regime prevailed in 1976:1-1976:4 and 1977:2.

A fundamental change to the monetary policy conduct in the United States occurred in August 1979, when Paul Volcker was appointed as a new chairman of the Federal Reserve. Volcker came up with an approach to pin down inflation expectations by dramatically lifting the interest rates. In particular, the federal funds rate, which was about 11% in 1979, increased to 20% by June 1981. The policy rate eventually reached 21.5% in June 1982. This reduced the money supply growth rate as well as the size of the Fed's balance sheet. Such a "hawkish" approach to monetary policy coincides with the transitions to the 'crisis' regime in 1980:3, 1981:1 and 1983:1. The contractionary monetary policy and 1979 oil crisis are also considered as the primary reasons for the early 1980s recession, where unemployment peaked at 10.8% in November and December 1982.

The economy started improving at a fast rate starting from the beginning of 1983. From a high of 10.8% in December 1982, the unemployment rate gradually reduced until it fell to 7.2% on Election Day in 1984. Inflation fell from 10.3% in 1981 to 3.2% in 1983. Fragile industries recovered and corporate earnings showed significant growth rates. Interestingly, the model shows that the economy often switched to the 'recovery' regime from 1982 up to the election in 1984. Although the sharp recovery from the early 1980s recession is generally attributed to Reagan's tax cut reforms, it is quite clear that monetary policy also played a significant role.

After that, the 'normal' regime prevailed in the economy until about 1990:3 in the period which is often referred to as the Great Moderation, where shocks had a minor influence on the economy. During this time there were only several "one-quarter" shifts to the 'recovery' regime. For example, this happened in 1987:4, coinciding with October 1987 stock market crash which did not translate into a recession and can be regarded as a minor capital quality shock.

Next time the United States entered the recession only in July 1990. The recession lasted about 8 months and is broadly regarded as relatively mild when compared with other post-war recessions. Despite being relatively mild, the recovery was quite sluggish when considering unemployment which peaked only in June 1992. This is probably why the 'normal' regime returns only in 1992:3. After that, the period of unprecedented economic expansion, Great Moderation, continued up to

the time of the financial crisis 2007-2008 (Great Recession). From 1992:4 to 2008:2, the only time when the economy transitioned away from the 'normal' regime was in 2002:4, which coincides with the economic slowdown due to the burst of the dot-com bubble.

Many economists consider the financial crisis 2007-2008 as the worst recession since the Great Depression of the 1930s. It began as a subprime mortgage crisis and with the collapse of the Lehman Brothers turned into a full-blown international financial intermediation crisis. The interbank lending almost froze, and only a coordinated response of monetary policymakers around the world and a series of large-scale bailouts prevented further bankruptcies of large financial institutions. Faced with a large shock, Fed sharply lowered the benchmark policy rate. Due to the effective zero-lower bound on the nominal policy rate, Fed also had to consider other options to bring the economy back to growth. Fed responded using so-called unconventional monetary measures, performing large-scale asset purchasing. Fed implemented LSAP (e.g., three rounds of Quantitative easing, TARP, etc.) by buying financial assets from commercial banks and other non-bank financial institutions, thus raising their value and lowering their yield in an attempt to boost the money supply and domestic expenditure. During the recovery period, the scale of such operations has been unprecedented, e.g., by 29 October 2014 when the Fed halted its purchases, they had accumulated about $4.5 trillion in assets, which was about a fivefold increase of their balance sheet. Due to such a dramatic expansion of the balance sheet, the modelled economy persists in the 'recovery' regime from 2008:3 to 2009:2 and in 2009:4. Although the economic consequences of the Great Recession were large, the policymakers were successful in restoring the economic growth relatively quickly. The estimated model is in 'normal' regime from 2010:1 until the final data point.

5. Conclusion

This paper extends a model of financial intermediation and unconventional monetary policy initially developed by Gertler and Karadi (2011) to include regime switching parameters.

I calibrate and estimate the model allowing for the possibility of switches across the regimes with different capital quality and unconventional monetary policy rule parameters. I perform two calibrations, where in one of them I allow for a possibility of a zero-lower-bound regime for the nominal policy rate. As a result, I find out that the mere possibility of the switch changes the behavior of agents and, hence, the dynamics of the economy even in non-binding ZLB regimes. Among examples is that when allowing for ZLB, in some regimes households may react to asset purchases as a sort of negative signal, which suggests that the low interest rate and inflation steady state may prevail for longer and households actually cut their consumption. The model with zero-lower bound produces much more reasonable dynamics, showing that just bringing about "helicopter money" not always works.

The estimation of the model reveals that during the recent financial crisis policymakers using forward guidance combined with large-scale asset purchases prevented the economy from hitting the bad regime. For future research, it would be interesting to estimate the model to Japan data and verify whether a transition to zero-lower bound regime can explain the "lost decade." Overall, the estimated regime probabilities match the economic history of the US reasonably well and capture every NBER recession. This means that the regime switching model better captures the US data and may be more suited for the analysis within Gertler and Karadi (2011) framework.

6.1 Appendix A

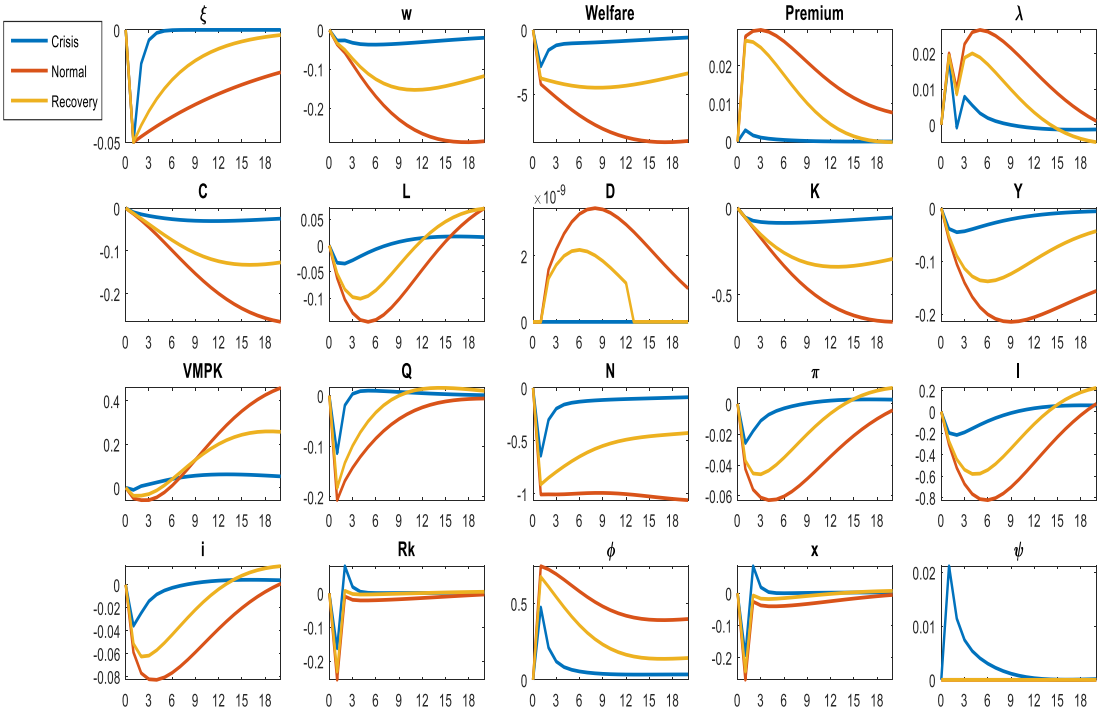


Figure 4.1. Impulse responses to capital quality shock.

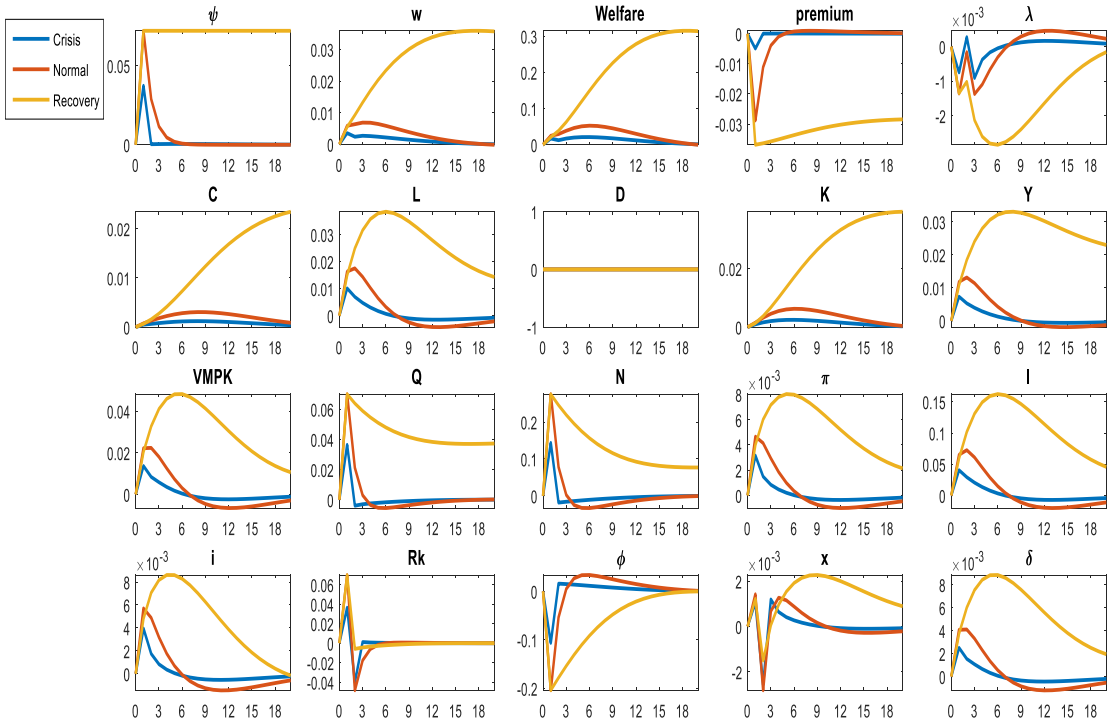


Figure 4.2. Impulse responses to central bank portfolio shock.

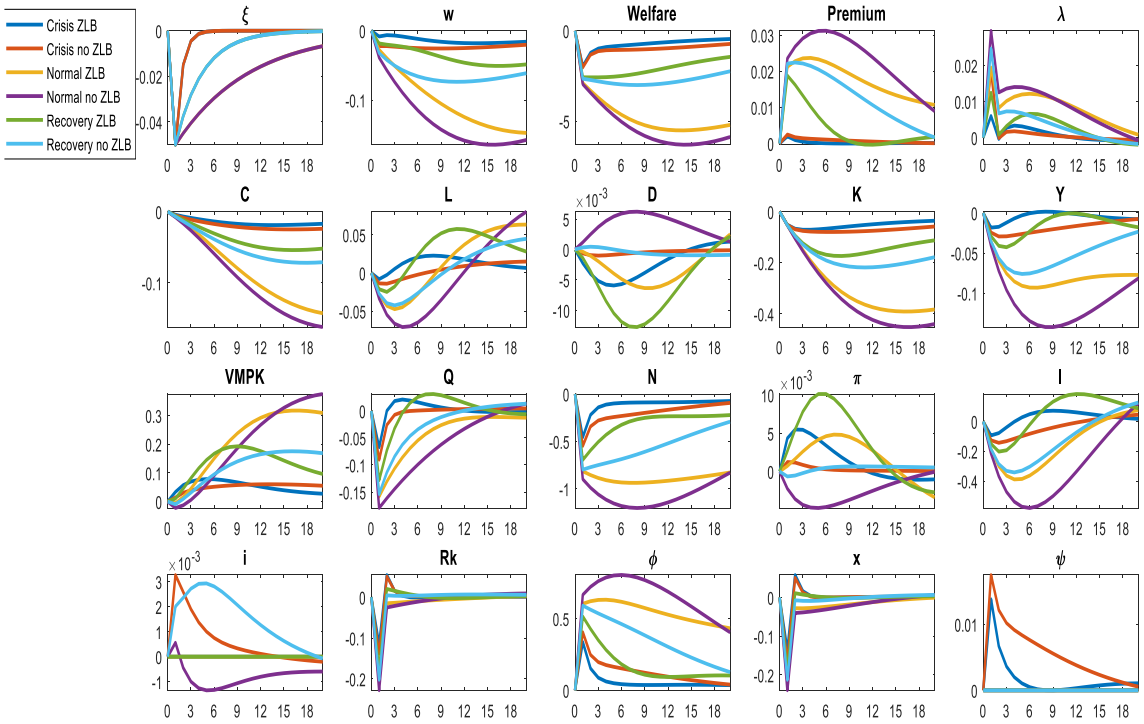


Figure 4.3. Impulse responses to capital quality shock in a model with Zero-Lower Bound.

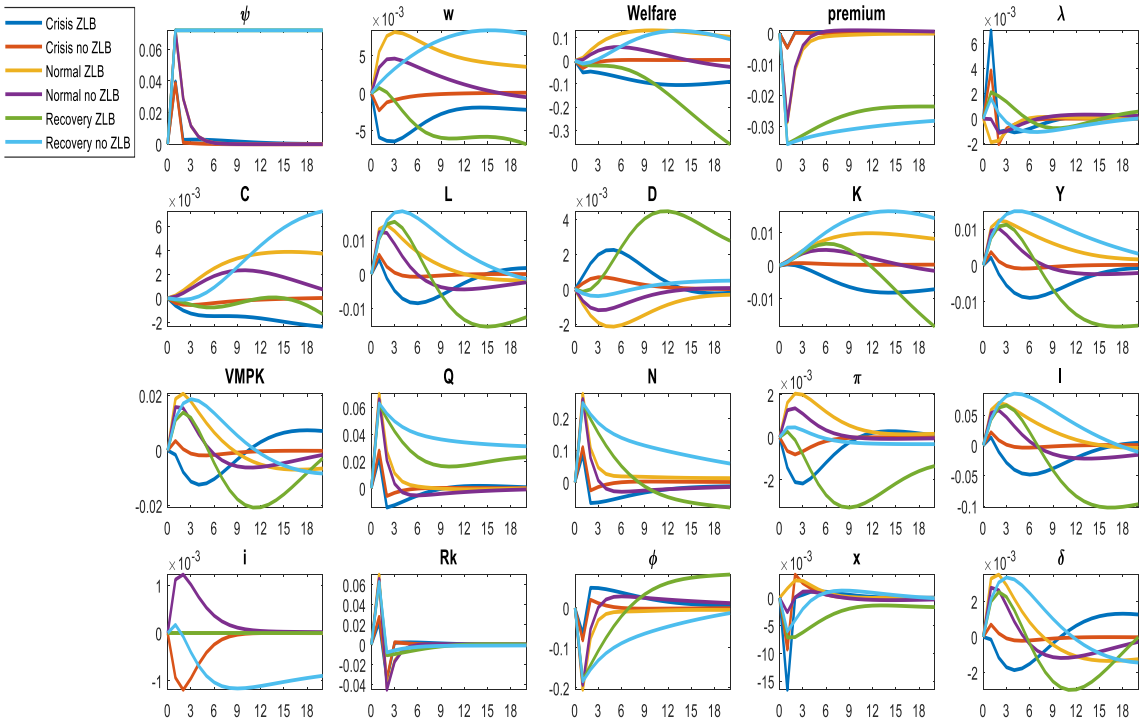


Figure 4.4. Impulse responses to central bank portfolio shock in a model with ZLB.

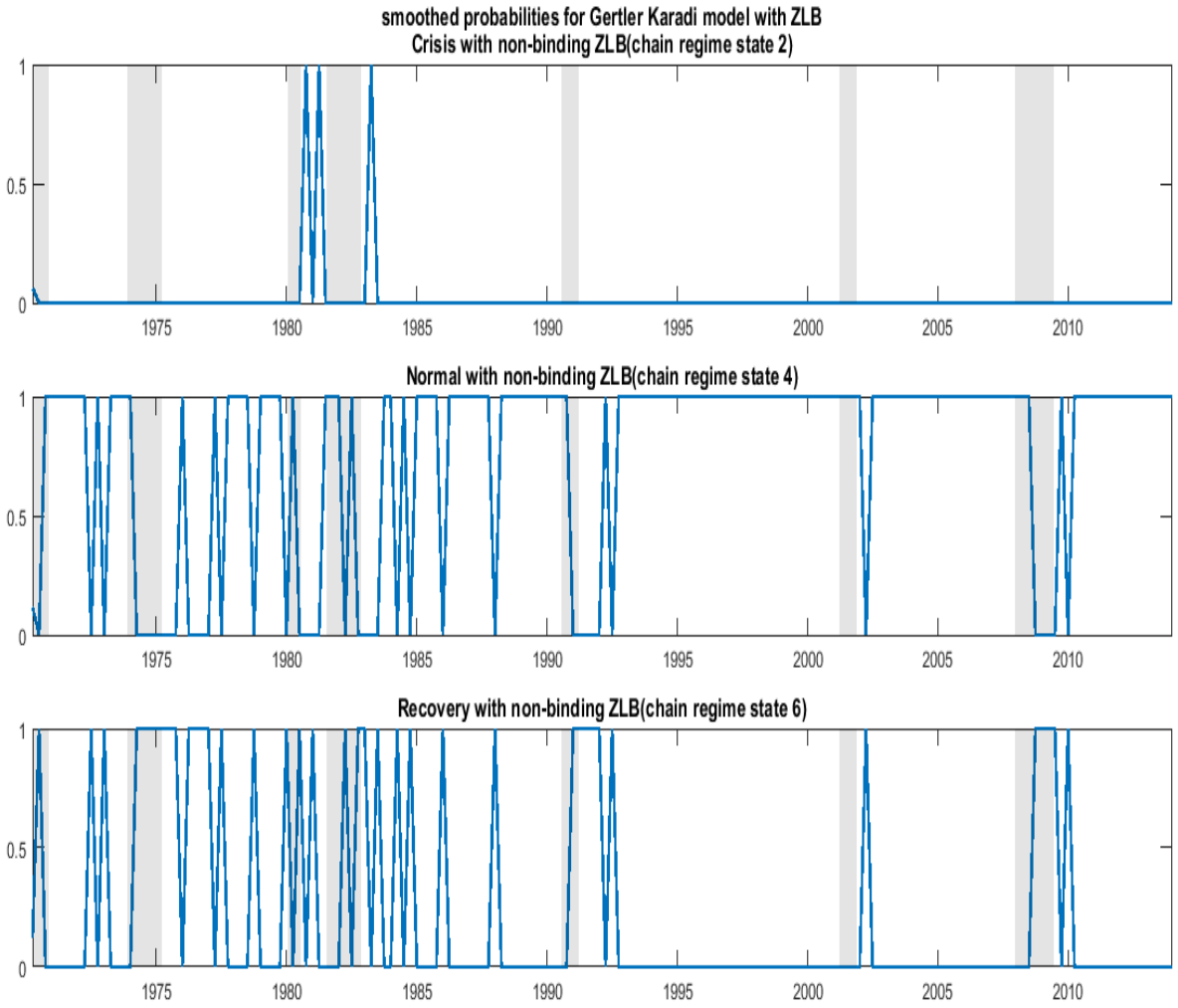


Figure 4.5. Smoothed probabilities of the regimes. Shaded regions indicate NBER recessions.

6.2 Appendix B

Table 4.1. Values of calibrated parameters used in the calibration

Parameters1	Value1	Description1	Parameters2	Value2	Description2	Parameters3	Value 3	Description3
β	0.990	Discount rate	ρ_g	0.950	Smoothing parameter in the government consumption shock	$p_{N,R}$	0.500	Transition probability from 'normal' to 'recovery'
h	0.815	Habit parameter	σ_g	0.010	Standard deviation of government purchases shock	$p_{R,C}$	0.200	Transition probability from 'recovery' to 'crisis'
φ	0.276	Inverse Frisch elasticity of labor supply	σ_{Ne}	0.010	Standard deviation of net worth shock	$p_{R,N}$	0.400	Transition probability from 'recovery' to 'normal'
ζ	7.200	Elasticity of marginal depreciation with respect to utilization rate	σ_i	0.010	Standard deviation of the Taylor rule shock	$\rho_\xi(1)$	0.300	Capital quality persistence in Crisis regime
θ	0.972	Survival rate of the bankers	σ_ψ	0.072	Proportional transfer to the entering bankers	$\kappa(1)$	7.000	The response to spread in Crisis regime
α	0.330	Effective capital share	τ	0.001	Cost of financial intermediation	$\rho_\psi(1)$	0.000	Central bank portfolio persistence in Crisis regime
η_i	1.728	Inverse elasticity of net investment to the price of capital	ω	0.002	Proportional transfer to the entering bankers	$\rho_\xi(2)$	0.900	Capital quality persistence in Normal regime
ε	4.167	Elasticity or substitution	λ	0.381	Fraction of capital that can be diverted	$\kappa(2)$	0.000	The response to spread in Normal regime
γ	0.779	Probability of keeping prices fixed	χ	3.411	Relative utility weight of labor	$\rho_\psi(2)$	0.400	Central bank portfolio persistence in Normal regime
γ_p	0.241	Measure of price indexation	δ_c	0.020	Steady state depreciation rate	$\rho_\xi(3)$	0.750	Capital quality persistence in Recovery regime
κ_π	1.500	Inflation coefficient of the Taylor rule	$\left(R_k - R_{ss}\right)$	0.002	Steady State Spread (Premium)	$\kappa(3)$	0.000	The response to spread in Recovery regime
κ_y	0.125	Output gap coefficient of the Taylor rule	G_{ss}	0.170	Steady state proportion of government expenditures	$\rho_\psi(3)$	1.0000	Central bank portfolio persistence in Recovery regime
ρ_i	0.000	Smoothing parameter of the Taylor rule	I_{ss}	0.142	Steady state proportion of investment	$p_{S,L}$	0.100	Transition probability from "no-ZLB" to "ZLB"
ρ_a	0.950	Smoothing parameter in the technology shock equation	$p_{C,N}$	0.030	Transition probability from 'crisis' to 'normal'	$p_{L,S}$	0.700	Transition probability from "ZLB" to "no-ZLB"
σ_ξ	0.050	Standard deviation of capital quality shock	$p_{C,R}$	0.500	Transition probability from 'crisis' to 'recovery'	zlb_flag(1)	1.000	"ZLB" regime in place
σ_a	0.010	Standard deviation of technology shock shock	$p_{N,C}$	0.030	Transition probability from 'normal' to 'crisis'	zlb_flag(2)	0.000	"No ZLB" regime in place

Table 4.2. Properties of estimated parameters

	Switching parameter	initial value	lower quantile	upper quantile	distribution	prior prob	Lower and upper bounds		posterior mean	posterior standard deviation
κ_π	No	1.200	1.100	1.300	Normal	0.950	1.010	1.525	1.294	0.003
κ_y	No	0.125	0.000	0.600	Beta	0.900	0.010	0.990	0.124	0.000
σ_a	No	0.010	0.000	0.500	Inverse gamma	0.600	0.000	2.000	1.692	0.001
σ_g	No	0.010	0.000	0.500	Inverse gamma	0.600	0.000	2.000	1.999	0.001
σ_{Ne}	No	0.010	0.000	0.500	Inverse gamma	0.600	0.000	2.000	0.355	0.005
σ_ξ	No	0.010	0.000	0.500	Inverse gamma	0.600	0.000	2.000	0.367	0.003
σ_ψ	No	0.072	0.000	0.500	Inverse gamma	0.600	0.000	2.000	1.921	0.001
ε	No	4.167	2.000	6.000	Inverse gamma	0.900	0.688	9.000	8.344	0.002
G_{ss}	No	0.200	0.000	0.300	Beta	0.900	0.000	0.992	0.142	0.001
ρ_g	No	0.950	0.900	1.000	Beta	0.900	0.315	1.000	0.739	0.002
$\rho_\xi(2)$	Yes	0.950	0.800	1.000	Beta	0.900	0.075	1.000	0.589	0.007
$\kappa(2)$	Yes	0.000	0.000	0.150	Beta	0.900	0.000	0.919	0.002	0.001
$\rho_\psi(2)$	Yes	0.400	0.300	0.500	Beta	0.900	0.096	0.770	0.254	0.002
$\rho_\xi(3)$	Yes	0.850	0.750	1.000	Beta	0.900	0.033	1.000	0.541	0.003
$\kappa(3)$	Yes	0.000	0.000	0.100	Beta	0.900	0.000	0.798	0.509	0.002
$\rho_\psi(3)$	Yes	0.980	0.900	1.000	Beta	0.900	0.315	1.000	0.670	0.001

Table 4.3. Properties of calibrated parameters in used estimation

Parameters1	Values1	Parameters2	Values2	Parameters3	Values3
β	0.99	θ	0.972	σ_i	0.0025
τ	1.00E-03	η_i	1.728	λ	0.3815
ω	0.0022	φ	0.276	$p_{C,N}$	0.03
χ	3.409	γ	0.779	$p_{C,R}$	0.5
δ_e	0.0204	γ_P	0.241	$p_{N,C}$	0.03
$\left(R_k - R_{ss}\right)$	0.0025	zlb_flag(1)	1	$p_{N,R}$	0.5
G_{ss}	0.1698	zlb_flag(1)	0	$p_{R,C}$	0.2
I_{ss}	0.1415	$p_{S,L}$	0.1	$p_{R,N}$	0.4
h	0.815	$p_{L,S}$	0.7	$\rho_\xi(1)$	0.2
ζ	7.2	ρ_i	0.8	$\kappa(1)$	7
α	0.33	ρ_a	0.95	$\rho_\psi(1)$	1.00E-04

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